

BRITISH INDUSTRIES
AND THEIR ORGANIZATION

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BRITISH INDUSTRIES AND THEIR ORGANIZATION

by

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TO
MY WIFE

Science and the spirit of emulation—those are the forces that have made us what we are.—*The Other Side of the Hedge*
(E. M. FORSTER)

Whether it be not the Opinion or Will of the People, exciting them to Industry, that truly enricheth a Nation?—*The Querist*
(GEORGE BERKELEY)

PREFACE

In the first edition of this book, which was published in 1933, I described the structure of certain British industries against the background of their historical development and at the same time I considered some of the more significant trends in British industry as a whole. Attention was then focused on the events and policies of the late nineteen-twenties and the early nineteen-thirties. In subsequent editions and reprints new material was added to cover the successive changes in the condition and organization of the several industries and in economic policy towards them. For the last edition published in 1951 the book was extensively revised and, apart from the sections that dealt with the history of industry before 1914, little remained of the book as it had originally appeared. The range of industries was widened and interest was centred on conditions in the years immediately after the Second World War.

Since then the post-war structure has taken shape, new industrial problems have appeared and new policies have been formulated and applied. For the present edition, therefore, the book has been largely re-written. The historical method of treatment has of course, been retained, for it was always an essential part of my purpose to trace the evolution of the various trades during the modern era. But post-war developments can now be viewed in perspective, and the centre of interest has shifted to the condition and organization of British industry in the late nineteen-fifties.

In the first chapter, which remains substantially unaltered, I have traced the chief features of British industrial growth up to 1914. In the second chapter, which has been much enlarged, my aim has been to provide an account, in outline, of the economic history of the period from 1914 to the present time so far as it is relevant to the main theme of the book. There are references to world economic trends as well as to purely domestic affairs, a brief discussion of economic policy, and a general description of the changes in the importance of the various British industries during the period. These two chapters are intended to provide the setting for the more detailed discussion that follows. All the remaining chapters are concerned with particular industries. As in earlier editions, I have preferred to examine a few

representative industries in some detail rather than to try to cover the whole field more superficially.

In a book planned on this scale, many important questions necessarily receive inadequate treatment, while some large matters (e.g. industrial relations) cannot be considered at all. I am conscious of these deficiencies. My hope is that this edition, like its predecessors, will be regarded as an introduction (and not more than an introduction) to the study of certain aspects of British industry that are of economic rather than of technical interest. The bibliography, which has been completely revised, contains suggestions for further reading.

Although the book is descriptive in character, I have not hesitated to put forward interpretations of the events described. Where I have touched upon controversial matters, however, I have usually suspended judgment; confident statements in this field are seldom easy to justify. Nor have I been ready with predictions based on past trends, for experience has revealed only too clearly the skill which participants in industrial life bring to the game of "Cheat the Prophet." The course of economic development is strewn both with the ruins of once-great industries and with the ashes of what to contemporaries seemed enduring problems.

My thanks are due to Dr. M. F. Lloyd-Prichard for assistance in collecting figures required for revising the statistical tables, and I am indebted to my wife for her help in preparing the manuscript for the press and in proof-reading.

G. C. A.

University College, London
August 1958

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CHAPTER I

BRITISH INDUSTRY BEFORE 1914

Between the end of the Napoleonic Wars and the outbreak of the First World War the economic life of the world was subjected to a more complete transformation than had been witnessed in any preceding century. Subsistence husbandry and manufacture for local consumers, which in 1815 still persisted over a great part of the world, gave place in the course of the nineteenth century to production for a wide market; and each community was impelled towards increasing specialization in its economic activities. In some countries great centres of population arose, each concentrating on the manufacture of particular classes of commodities for consumers in every part of the world. Sometimes the increase in the magnitude of an industry which accompanied the change in its functions took place without any profound modification of its structure. More usually, however, a new type of industrial organization was created, and the merchant, or factor, with his dependent domestic producers, or outworkers, gave place to the manufacturer with a factory operated by power machinery. Production for a wide market was assisted by new forms of transport which, in turn, involved an increase in the mechanical equipment of society and so created new large-scale industries.

The industrial structure of the nineteenth century brought with it changes in the geographical distribution of economic activities. The areas or countries which could best adapt themselves to the conditions of the new era gave up many of their traditional pursuits in order to concentrate on those yielding larger returns. Thus, it is said that Durham, "the home of lost industries," let slip many of the minor trades on which it was at one time engaged, because of the higher rate of profit which could be earned in iron manufacture and shipbuilding.¹ The decline in the importance of Glasgow as a cotton centre is attributable to the same cause.² This tendency for areas to concentrate on those activities in which their comparative advantages were greatest could be observed internationally. For

¹ H. A. Mess, *Industrial Tyneside*, pp. 43, 50.

² C. R. Fay, *Great Britain from Adam Smith to the Present Day*, pp. 159-60.

example, Japan abandoned the production of cotton when cheap supplies from India and America became available, and she replaced this crop by the cultivation of mulberries as a basis for her expanding trade in raw silk. Some countries and some areas increased in economic importance as a result of this redistribution of industries; but in others, where the capacity for adjustment to the new conditions was lacking, ancient trades were destroyed without any compensating rise of new ones. Technological advance has frequently resulted in the sacrifice of one country to the economic benefit of the world.¹ Just as many flourishing industrial centres in the south of England decayed as the coal-fields of the north began to exercise their attracting power, so whole countries lost substantial trades without securing others of equivalent value, and declined industrially through the rise of British manufactures. The ancient cotton industry of India, for example, was partly destroyed by the importation of the cheap machine-made goods of Lancashire, and for a time its people had to confine themselves more exclusively to agricultural pursuits. Sometimes, no doubt, the decay of an industrial area or country could be attributed to the marked natural advantages of its competitors; but, not infrequently, mere lack of adaptability rather than any obvious inferiority of situation or resources brought the decline. The disappearance of the textile industry from East Anglia in the face of Yorkshire competition has been explained in this way.² It is true that established industrial areas usually possess solid advantages over others for attracting new trades, which are often built on the ruins of the old. On the other hand, whenever a great change in technique or organization occurs, the older seat of an industry will have difficulty in maintaining its position if it clings to the processes and methods which have brought success in the past. This is a temptation to which newcomers are not exposed.

The increase in geographical specialization brought greater advantages to Great Britain than to other countries because of the culmination of causes which had destroyed restrictions on her industry and commerce, had given her access to foreign markets, and had made her peculiarly suited to the new methods of mechanical production. The result was to leave her at the end of the nineteenth century with a highly specialized economic life, based primarily on manufacture and commerce, and with a number of great staple industries of which the products were distributed throughout the world.

¹ Cf. A. L. Bowley, *England's Foreign Trade in the Nineteenth Century*, p. 15.

² J. H. Clapham, *An Economic History of Modern Britain, 1820-1850*, p. 42.

The industrial development of Great Britain during the century before 1914 may be roughly divided into four periods. The first stretches from 1815 to 1850; the second from 1850 to 1875; the third from 1875 to 1900; and the fourth from 1900 to 1914.¹ Although the first period was marked by serious social upheavals, and by a prolonged depression in agriculture, it witnessed a remarkable increase in production. Indeed, in terms of the rate of change in industrial production, the volume of imports and exports, and the level of real wages, the period showed "perhaps the most rapid rate of development of domestic resources throughout the whole of Britain's economic history."² These were the years in which the modern industrial structure was taking shape, and when the history of foreign trade was "the history of the division of the world into new countries producing raw materials and old countries manufacturing them."³ In the interests of cheap food and industrial specialization, British restrictions on commerce were gradually abandoned in favour of free trade, and by 1850 the volume of British exports was three times as great as at the beginning of the century. A multitude of industries established themselves on the coal-fields, many of them having shifted from the south; but industrial growth was mainly associated with the expansion of the cotton trade and with the emergence of Lancashire as a great manufacturing and exporting area. Between 1835 and 1840 exports of cotton goods formed nearly one-half of the total exports of British produce. This was the period when, not unnaturally, "the theory of foreign trade was conceived in terms of corn and cotton."⁴ The traditional trade in woollen goods had grown substantially after 1815, but its importance had been eclipsed by the rise of the newer textile industry. In the late forties textiles as a whole accounted for over two-thirds of the total exports of domestic products.

During the next twenty-five years, the rate of growth in production was only slightly less than in the previous period. There was an increase in the size of the textile industries; but their relative importance in the British industrial system, though not in the export trade, declined, because of the rapid advance of the metallurgical trades. The rise of these industries was associated with the development of railways and shipping, and with the expansion in the world's material

¹ Cf. A. L. Bowley, *op. cit.*, *passim*; and G. D. H. Cole, *British Trade and Industry*, Chaps. II-VI.

² W. W. Rostow, *British Economy of the Nineteenth Century*, p. 19.

³ A. L. Bowley, *op. cit.*, p. 3.

⁴ C. R. Fay, *Life and Labour in the Nineteenth Century*, p. 204.

equipment which depended largely on British iron. Throughout this period Great Britain was making large annual additions to her foreign investments, and as the borrowing countries employed part of these loans in the purchase of machinery and transport equipment, the iron industries were stimulated to exceptional activity. At the same time the leading European countries, with the example of British success before their eyes, were becoming increasingly liberal in their tariff policies, and of this the British exporters were able to take full advantage. The end of the period coincided with the boom generated at the time of the Franco-Prussian War, and it witnessed the culmination of Britain's industrial supremacy.

During the last quarter of the nineteenth century industrial progress, though considerable, was of a more hesitating kind. A new era had begun. Countries which had been hindered up to 1875 by political disunity now began to take a place, hitherto monopolized by Great Britain, as producers and exporters of manufactured commodities. For some industries these countries were more suited than was Great Britain, especially as at this time improved manufacturing processes, of which new producers could take full advantage, were being introduced into many trades. "In the heyday of her [Great Britain's] early start, she had gone successfully into lines of business for which she had no enduring advantage. Once competitors entered the field, she came under growing pressure to discover and maintain those branches of work for which she had the greatest aptitude, and to withdraw from the rest."¹ The fall in ocean freights towards the end of the nineteenth century was partly responsible for the readjustments in the British industrial system; for it resulted in a decline in the price of imported materials, particularly grain, to British consumers; while certain of our industries (notably coal) obtained access to foreign markets from which they were formerly debarred by the high cost of transport.

With the revival of economic nationalism, and with the onset of the "great depression" in 1874, import duties abroad were raised, and some British trades suffered in consequence. The volume of exports, it is true, continued to expand, though at a reduced rate; but supremacy in the iron and steel trades was lost, and in the textile industry was challenged. The hardware trades decayed in the face of German competition, and, most serious of all, there was a rapid decline in agriculture. The optimism of earlier decades was replaced

¹ W. H. Beveridge, *Unemployment*, p. 381.

by doubt and uncertainty. A distinguished economist, writing in 1902, emphasized the significant fact that the only exports which had made a substantial advance during the previous thirty years had been coal and those products which employed cheap unskilled labour. It seemed to him that Britain would soon have the greatest relative advantages only in trades which involved the destruction of an irreplaceable raw material or depended on her resources of "sweated labour." The rest of her industry was in danger of decay before the scientific prowess of Germany and the large-scale production methods of the United States.¹ Yet, throughout this period of apparent adversity, production per head and real wages continued to advance, and new industries, such as the bulk steel, electrical and bicycle industries, came into being. It may be argued, therefore, that it was a period of instability rather than of decline, and that the general depressions which recurred with such frequency and severity were merely symptoms of economic adjustment to a new world. In support of this view, it may be shown that complaints of foreign competition have never been absent from business annals, and that they are met with in times of great progress as well as in periods of comparative stagnation. Indeed, any marked advance in the productive efficiency of the majority of a country's industries is certain to be accompanied by a decline of others in the face of foreign competition. This will occur because industrial success will tend to raise the remuneration of capital and labour throughout the country to a level higher than that which the lagging minority can support. Thus the decay of some industries may well be the result of an increase in the productive power of the country as a whole, and the remedy to be sought is the redistribution of the country's resources among the trades in which its relative advantages are greatest. The rapid industrial progress of many competitor nations after 1875 increased the necessity for this adjustment; but the growth in the British income per head would seem to show that it was successfully achieved.² Yet the arguments of the pessimists had force. Great Britain had lost her predominant position. She now had to struggle with a number of powerful competitors for the world's markets; and since she was a country dependent in an exceptional degree on foreign trade, her industrial system had become more unstable than in the days of her supremacy. "It may . . . be a true instinct which

¹ W. J. Ashley, *The Tariff Problem*, p. 112.

² A favourable shift in the terms of trade, in consequence of the cheapening of food imports, was an important cause of this improvement.

forsees the decadence of national prosperity in any special change of industry.”¹

The turn of the century, however, banished these misgivings, and it seemed that Great Britain had succeeded in adapting herself to the conditions of strenuous international competition. Such depressions as occurred were short-lived. There was a great expansion in all the staple trades—coal, cotton, wool, iron and steel, and engineering—and exports rose by leaps and bounds. The increase in exports of metallurgical products was exceptionally great, largely because of heavy foreign investment during this period. At the same time a number of new industries, such as the motor, cycle, rubber and electrical apparatus trades, were beginning to take an important place in British industrial life. Those who called attention to the declining British share of the world's exports could easily be refuted by the argument that a relative decline was inevitable when other countries entered the field, and that this was unimportant in view of the absolute expansion. If Great Britain could no longer claim supremacy, she could, at any rate, laugh at the prophets of positive industrial decline.

Yet there were indications of a less hopeful future. The increasing share of coal in the export trade of the country was looked upon with apprehension by many observers. In a comparatively short space of time, it was argued, the easily accessible coal would be approaching exhaustion, and the attendant rise in price would destroy both the coal export trade and the whole basis of British industrial life. Further, in 1914 Great Britain still depended, to a greater degree than other nations, on the staple industries on which she had specialized in the nineteenth century; and in the newer trades—in the manufacture of motor-cars, electrical apparatus and machine tools—she was by no means in the first rank. Finally, it appears that, with the rise in general prices after 1896, the steady improvement in the material condition of the wage-earners which had occurred during the last half of the nineteenth century came to an end; for money wages showed no increase corresponding to the rise in the general price level.² Rising prices gave a stimulus to the entrepreneur by increasing his margin of profit, and assisted the accumulation of capital for foreign investment; but the industrial activity which resulted was won in some degree at the expense of the workers. This change in the distribution of the national income was

¹ A. L. Bowley, *op. cit.*, p. 15.

² A worsening in the terms of trade was partly responsible for this change.

reflected in the social unrest and the rise of militant trade unionism in the years just before 1914. The period under examination was too short to enable the economist to judge whether these tendencies would have persisted had there been no war. It seems probable that the rate of growth of capital investment within Great Britain had slackened and that this was associated with a cessation in the decline in real costs in certain industries. Nevertheless, in 1914 the great staple trades still retained a firmly established position in the world's economy, and although there were some grounds for misgivings, there was little hint of the misfortunes to come.

Before passing to a consideration of these staple trades which will be our main concern, we will glance at the economic system in which they had their being. Nineteenth-century industrialism had its foundation in the principle of natural liberty, or *laissez-faire*. This principle was never fully expressed in the practice of nations; but in the Western world there was a general assumption in favour of economic freedom and against any attempt to subject trade, investment and industrial development to social control. The classical economist envisaged a cosmopolitan society. He held that in order to secure a maximization of wealth, which was regarded as a desirable end, each community should concentrate on those economic activities in which its relative advantages were greatest. As the world was at this time moving forward rapidly under the impetus of great technical discoveries, the rise and fall of industries and the adaptation of particular areas to new conditions were necessary and continuous processes in an economic system moulded by this principle. The impulse behind these changes was provided by the profit-seeking motive of the entrepreneur who was guided by price changes. For its satisfactory operation the system involved a high degree of mobility both of capital and of labour; for a country with special advantages in a particular industry when one method of production was followed could not count upon retaining its predominance if a change in methods should occur. For example, during the era of wooden ships before 1850 the United States ranked as a leading shipbuilder, but this position they soon lost on the introduction of the iron ocean-going steamship.

Yet the very conditions of nineteenth-century production reduced this elasticity which was necessary if the economic system was to function without grave losses. In areas with a variegated economic life and where industrial units were small, changes might be, and were, effected with comparative ease. But the new industrialism

frequently involved the creation of large producing units and specialized manufacturing areas. Where these existed, the decay of the local industry resulted not only in heavy capital losses but also in great social distress; for surplus labour from the decaying trade could not easily transfer itself to others geographically remote. Under an individualistic system, however, these heavy costs of industrial change did not fall on the shoulders of those responsible for it. The question of introducing a new manufacturing process was not decided by reference to the net advantages which the community might secure from it; for those who reaped the profits were not called upon to meet the costs of adjustment which its introduction entailed. A powerful stimulus to innovation was, therefore, continually in active operation, and new trades and new forms of organization were constantly rising on the ruins of the old. Similar influences were at work in determining the allocation of a community's resources. Economists have shown that certain costs, incurred through the operations of a particular industry, are not normally debited to that industry, but are borne by society as a whole, or by some section of it other than the entrepreneurs concerned. Because of this, certain trades, under *laissez-faire*, tend to reach a greater magnitude than is warranted by the net contribution to national wealth of the factors employed in them. Thus, while industrial individualism stimulated the adoption of improved methods of production and might pass without serious challenge in a period in which communities were lifting themselves from a plane of primitive equipment and scanty wealth, it did not promote the optimum distribution of resources. It came under attack as soon as a nation had reached a higher economic plane and had become concerned with the stability of the standard of life of each social group rather than with increasing the total national wealth.

In the first part of the nineteenth century the methods of promoting and controlling industrial units were in conformity with this *laissez-faire* principle. The earlier generation of industrialists was drawn mainly from two sources. Some came from merchants who had previously employed domestic craftsmen and who, on the introduction of power-machinery, began to establish factories. Others originated with craftsmen themselves, who built up large establishments from small beginnings. As time went on sub-contractors, or overhands, left the factories in which they had been employed and founded businesses of their own. Up to the end of the nineteenth century the typical business in nearly all the mining and manu-

facturing trades of the country was controlled by individuals or partners who themselves owned the capital. They were assisted in their operations by loans from the banks or from merchants through whom they dealt; but for additions to their fixed capital they depended on the re-investment of their profits. The savings of the professional and *rentier* class were largely invested through the London market in foreign enterprises and government stocks, and there was, therefore, a fairly clear division between the machinery for providing industry with capital and that for conducting foreign investment. Indirectly, a close connection between them existed; for, as already indicated, the flow of capital abroad had far-reaching effects on the industrial position of the country. The immediate influence of investment in foreign railways, shipping and public utilities was to stimulate the growth of the British heavy industries; but the ultimate consequences are more difficult to assess. Since the export of capital hastened the development of the resources of new countries, it increased their capacity for purchasing British goods on the one hand, and on the other it enabled Great Britain to secure raw materials and foodstuffs more cheaply than before. Yet, in so far as the export of capital resulted in the establishment of foreign industries producing goods in competition with British exports, it threatened the existence of long-established British trades and it enforced a redistribution of British productive resources sooner than would otherwise have happened. So, against the advantages accruing to Great Britain from a general increase in the wealth of the world and from the higher profits on foreign investment compared with those which might have been earned at home, must be set the dislocation and loss in which particular industries and social groups were involved. It has also been claimed that the diversion of so much capital abroad was to the disadvantage of industrial efficiency within Great Britain by depriving home industries of resources which would have permitted them to introduce cost-reducing equipment. Certainly, the result of heavy foreign investment was to increase the instability in British economic life, especially as the British industries most enlarged by this policy were themselves liable to severe recurrent fluctuations in activity. Under the conditions of early nineteenth-century industrialism the mortality among the sole traders and partnerships was very high, and every depression saw the disappearance of innumerable business units from every industry. As the liability of the owners for the debts of their business was unlimited, it is clear that if industrialism brought

great profits to the entrepreneur, it also involved him in enormous risks.

Up to the "great depression" (1874-86) the high costs of this system, due to its dynamic character, were overshadowed by the concomitant advance in national wealth. Where losses had been suffered by large groups (e.g. the hand-loom weavers and agricultural labourers after 1815, and by the nailers after 1830), the injured had been neither vocal nor powerful. Their degradation was regarded as part of the inevitably heavy social costs attending the introduction of a new era. After 1875, however, conditions of international trade began to change, and the industrial readjustments required placed a great strain on the economic system. Large established industries, notably the iron and hardware manufactures and agriculture, began to suffer. This led to criticisms of *laissez-faire* and to the enunciation of economic policies based on the need for stability and security. Among these, the policy of protection began to secure new adherents. Protection meant, in essence, the effort to maintain the *status quo* even at the sacrifice of the greater national wealth which might be secured by readjustment. But Great Britain, under the influence of free trade, had become committed to industrial specialization. She depended so largely on foreign commerce that it was generally believed that she could not change her fiscal system without endangering the basis of her commerce.

A second criticism of *laissez-faire* came from the socialists. They were concerned with a more equitable distribution of wealth rather than with maximizing its production, and they aimed at abolishing the state of society in which the profit-seeking motive was the impulse behind change and progress. Long before this, organizations had appeared among the workers for the purpose of maintaining and improving wages by securing control over the supply of labour. In this way fluctuations in the demand for labour might be prevented, within limits, from affecting adversely the remuneration of the workers, since a union with a monopoly of the labour supply might withhold it from the market in order to obtain the price it required. Before the end of the nineteenth century, however, the proportion of workers organized in effective trade unions was small, and the elasticity of wage-rates, demanded by *laissez-faire*, was largely maintained. But the failure of real wages to rise after 1900 helped to strengthen the trade union movement, and at the same time social legislation was tending to weaken the pressure of eco-

conomic forces on the worker and to give him greater security. The establishment of governmental machinery to fix minimum rates of wages in certain "sweated" trades (by the Trade Boards Act, 1909) and in coal-mining (Coal Mines Minimum Wage Act, 1912), the limitation by law of hours for adult men in coal-mines (1908), and the beginnings of State social insurance (1911) are all instances of this departure from *laissez-faire*, as it was popularly understood.

Among the employers, also, the demand for greater stability and security became stronger as the nineteenth century drew to its close; and the competitive basis of industry was slowly undermined. This change is to be explained partly by the new conditions of international trade to which reference has been made, but mainly by the growth in the scale of enterprise which had accompanied technical advance. When the typical industrial unit was small, the adjustment of capacity to changes in demand might take place rapidly by the elimination of firms in a decaying trade, and the appearance of new ones in others. In periods of general depression, also, equilibrium might be quickly re-established by the removal of the producers with high costs. This elasticity in response to price changes would be found in an economic system dominated by small firms, not only because each manufacturer's resources were small, but also because he had little inducement to continue to produce once his margin of profit had greatly diminished. These conditions would be most prominent in trades in which the employer was a merchant and did not provide the workplace or tools; for he would have no "cost of idleness" to meet, and the burden of industrial fluctuations could then be thrown on the workers or the community. With the rise in the scale of industry and in the amount of fixed capital employed, the response of producing capacity to downward movements in price became less immediate. The elimination of the unfit was a slow process when an industry was in the hands of firms with great resources. A concern working with a large fixed capital was ready, in times of depression, to accept orders at any price which would contribute something to its heavy standing charges. Under these circumstances, a long period of unprofitable prices might ensue without leading to the extinction of surplus capacity.

The result was, naturally, a weakening of the industrialists' belief in the beneficence of free competition, and efforts were made by them in every manufacturing country to create combinations for the purposes of maintaining prices at profitable levels. These attempts to give greater security to the capitalist were assisted in England by the

provisions of the Companies Act of 1862. This enabled a firm to obtain the privilege of limited liability merely by an act of registration, and so made the penalties of defective business judgment less severe than formerly. The rise of the public joint-stock company altered greatly the character of industry. Huge concerns could now be built up from the savings of a multitude of investors who had little share in the management, and a division between the ownership and control of business enterprises began to appear. The combination movement, also, was assisted by the appearance of the limited company; since a concern might acquire control of others, not by purchasing their assets, but merely by obtaining a solid block of their shares.

Before 1914 the combination movement had proceeded much further in America and Germany than in England. Abroad, in the coal, iron and steel and engineering industries as well as in the newer trades like oil, motor-car and canned-meat production, large concerns were built up by a process of combination, and most industries were also honeycombed with agreements in restraint of free competition. There were many examples of combination in England; but in the staple trades independent family businesses remained the typical form of organization. Where combinations were numerous, as in the iron and steel trade, the most effective of them were vertical in character. The persistence of competitive conditions in British industry has been variously explained. The main reason is probably to be found in the free trade policy of the country on the one hand, and in the dependence of most of the staple industries on foreign markets on the other. These conditions made a policy of price control impracticable for groups of producers in most industries, and so weakened the inducement towards the formation of monopolies.

The British dependence on the varied demands of numerous foreign markets explains in some degree the reluctance of British industry to adopt the policies of standardization and specialization which, even before 1914, were enabling foreign manufacturers, particularly Americans, to lower their costs. Consequently, not only the typical concern, but also the typical establishment, or factory, remained smaller in most of the British staple trades than in those of the Continent and of America. It was to be expected that the American manufacturer, with the huge uniform demand for his products and with a relatively small supply of skilled labour, should adopt different methods from those of the English manufacturer

who was supplying diversified markets. Whether this provides a complete explanation of the contrast is debatable. Some critics believed that British industry was suffering from inertia and complacency, penalties of its early start.

In the sphere of marketing, for similar reasons the alteration in methods, which became apparent throughout the world during the twenty-five years before 1914, hardly affected Great Britain. This country had possessed a foreign trade of considerable volume even before the appearance of the modern industrial system, and its development necessarily depended on the enterprise of merchants. As time went on these merchants acquired great experience of the conditions in the various foreign markets; they built up valuable connections with customers; and the British manufacturers of the early nineteenth century naturally looked to them to distribute their goods. Usually the merchant purchased goods outright from makers, or from factors, and undertook the risk of disposing of them overseas. At a time when the world was eager to purchase British goods, and when this country was the only great manufacturing centre, the system was satisfactory, and the merchant played an essential part in the creation of a great British export trade. The dominance of the merchant and factor, it is true, sometimes led to cut-throat competition for merchants' orders among the factory proprietors with detrimental effects on the wages of their employees, and it brought especially degraded conditions to the domestic workers. Still, in a period when "prices were smashed by Bolton versus Glasgow on the markets of Europe rather than by England versus France or Germany,"¹ there were no grounds for supposing that the system might adversely affect either the competitive position of the British manufacturer *vis-à-vis* the foreigner, or the development of the British export trade.

With the development of industrialism abroad certain weaknesses in this system, from the manufacturer's standpoint, became evident. A British manufacturer might incur expenditure by the provision of samples for a particular market in the expectation that demand would eventually become sufficiently great to enable him to cover these initial costs and to earn profits on substantial orders. Yet, owing to the division of interest between the merchant and the producer, there was no reason why the former should continue to favour the original supplier. Indeed, when foreign competitors arose who could produce the goods more cheaply than the British firm,

¹ C. R. Fay, *Great Britain from Adam Smith to the Present Day*, p. 349.

the merchant might place his orders with them. So, in some instances, British experience in foreign trade and the British financial services were employed in the promotion of German industry at the expense of the British manufacturer. This was a result to which the liberal economist could not object, since it presupposed specialization according to capacity. Sometimes it happened that foreign manufacturers, finding British suppliers firmly entrenched in overseas markets, were themselves obliged to offer special inducements to potential customers and to adopt a new method of marketing their goods. Manufacturers, either as individuals or as groups, often with the support of their banks, began to establish their own selling organizations for dealing with foreign markets. The large scale of many Continental and American enterprises and the absence of established merchant-houses encouraged this development. Although direct selling of this kind might be more expensive in the initial stages than sales through merchants, it could be justified on the grounds that it was necessary in order to break the British trading monopoly, and that it ensured an even flow of orders to a particular manufacturing concern or group. This last consideration was especially important for producers with heavy fixed charges; for the extra expense of selling might be more than counterbalanced by the reduction in manufacturing cost consequent upon steadier trade. Although firms producing costly goods for other manufacturers or commercial concerns have always sold direct to the user, in the field of consumption goods there had been little departure on the part of British firms from their traditional methods of sale in the years before 1914. The established position of the merchant, the relatively small size of the typical firm, and the lack of co-operation among British manufacturers for marketing purposes, all constituted obstacles.

CHAPTER II

THE COURSE OF INDUSTRIAL CHANGE, 1918-1958

I

British Industry at the end of the First World War

During the war of 1914-18 the normal process of development and of adaptation to changing conditions was interrupted. Man-power and other resources were transferred from peace-time activities to serve the needs of war, with the result that some industries grew abnormally large while others declined. Fixed capital equipment was run down; the price and cost structure was distorted; and international economic relationships were profoundly altered. Even though, once fighting had ceased, the re-absorption of man-power into peace-time occupations was accomplished quickly and smoothly, business decisions continued to be affected for several years by sudden changes in economic conditions, and these changes were hostile to cool judgment. From the spring of 1919 to the early summer of 1920 there was a boom which was accompanied, both in Great Britain and abroad, by a steep rise in prices and wages, and this was followed by a slump from which the country did not begin to recover until the end of 1922. During the boom, industry was engaged in overtaking the arrears of maintenance of capital equipment and in rebuilding stocks of working capital, as well as in satisfying the needs of consumers. Employment was high; but production failed to recover completely to the pre-war level largely because of the disorganization that inevitably attended the transition to peace. The reduction of about 10 per cent in the length of the normal working week also had an important effect. Exports, which had fallen sharply during the war and in 1919 were 45 per cent less in volume than they had been in 1913, recovered slowly, and in 1920 they were still 30 per cent less than before the war, although they were sold at very high prices.¹

Thus, even in 1921, the industrial structure of the country still

¹ A. C. Pigou, *Aspects of British Economic History, 1918-1925*, p. 65.

suffered from the distortions caused by the war and immediate post-war conditions, and these distortions were reflected in the figures, which the 1921 Census of Population made available, of the distribution of man-power among the several industries. Nevertheless, it is convenient to begin the discussion of the inter-war experience of British industry by quoting certain of those figures. They are set out in the following table.

<i>Industry</i> ¹					<i>Number of persons engaged</i>
1. Mining and quarrying	...	...	...	...	1,464,000
2. Metal, machine, conveyance, jewellery, watch	...	...	...	...	2,565,000
3. Chemical and paint	...	...	...	...	215,000
4. Textile	...	...	...	...	1,305,000
5. Clothing	...	...	...	...	873,000
6. Food, drink, tobacco	...	...	...	...	623,000
7. Paper, stationery, printing, book-binding	...	...	...	...	403,000
8. Woodworking	...	...	...	...	314,000
9. Brick, pottery, glass	...	...	...	...	189,000
10. Leather (<i>not</i> boots and shoes)	...	...	...	...	86,000
11. Building and civil engineering	...	...	...	...	794,000
12. Other manufactures	...	...	...	...	205,000
TOTAL					<u>9,036,000</u>

Statistics of man-power distribution afford a broad indication of the position of the various industries in the economy; but when used for this purpose they must be interpreted with caution. In the first place, as a guide to the relative importance of the different trades, they are defective in that they ignore variations in net output per head which, of course, are closely affected by differences in the amount of capital equipment used per worker. Further, industries do not necessarily attract or shed labour at a rate corresponding to changes in the marginal productivity of the workers in each of them, for the transference of workers from one trade to another is impeded by obstacles of a social and institutional character. Again, statistics that purport to show the industrial distribution of man-power suggest a precision of definition which does not accord with reality. Even at a particular point of time it is not easy to distinguish some trades sharply from others, and when an attempt is made to compare their magnitude over a period, complications arise because the scope and character of each industry are constantly changing. As fresh

¹ See Committee on Industry and Trade, *Survey of Industrial Relations*, pp. 403 *et seq.*, for a convenient further analysis of these groups. The figures are for Great Britain, as is the case with all the tables in this book, except where otherwise stated.

products are introduced, so the older trades give rise to new branches, and these gradually develop into separate industries. Many firms, moreover, have a great diversity of products which may be regarded as falling within the sphere of several industries, and the relative importance of each product in a firm's output may vary from year to year, or even from month to month. An accurate comparison of magnitudes through time obviously cannot be made when the definition of the phenomena to be compared is constantly changing.

With these qualifications in mind, we may approach the figures shown in the reports of the 1921 Census, and we may regard them as giving a broad indication of the distribution of labour at the end of the post-war boom. At that time there were in Great Britain 28,300,000 persons of working age, i.e. between the ages of fifteen and sixty-four inclusive, and the number who actually followed definite occupations was 19,360,000. Of these just under 9 million were in Transport and Communications, Commerce and Finance, Public Administration and Defence, Public Utilities, and Professional and Personal Services; just under 1,400,000 were in agriculture, horticulture and fishing; and just over 9 million were in the manufacturing and mining industries shown in the above table. It is significant that this last group, even in a predominantly industrial country such as Great Britain, provided considerably less than half of the total employment.

The table brings out the massive importance of three groups among the industries listed there, (1) metals, chemicals and engineering, (2) textiles, and (3) mining and quarrying. In these three groups are found the staple exporting trades which rose to greatness in the course of the "industrial revolution." Throughout the nineteenth century they occupied a key position in Great Britain's economy, and were the basis of her supremacy. Their products enjoyed a world-wide market, and the British superiority in these trades enabled food and raw materials to be acquired on good terms for the expanding population. The shipping, commercial and financial activities of the nation were closely associated with their prosperity, and it was their interests which largely determined the economic policy of the country. Within these groups, too, arose the most important of the new manufactures, e.g. the motor, rayon and electrical trades, which in the last generation did so much to modify the character of British industrialism.

During the fifty years before the Census of 1921 the relative importance of these three groups of exporting trades in the economic

life of the country had increased, largely at the expense of such industries as agriculture, building and leather.¹ Between 1901 and 1911 the numbers engaged in the coal-mining, metal, engineering and textile trades, together with those in the clothing and chemical manufactures, increased by nearly 20 per cent, whereas the total occupied population increased by only 12.5 per cent. Between 1911 and 1921 the increases were 20.5 per cent and 5.5 per cent respectively.² These substantial changes in the distribution of the working population were due almost entirely to the expansion of two groups; coal-mining and the metal and engineering trades. The chemical trade also provided nearly three times as much employment in 1921 as in 1901, but it was a relatively small industry at the beginning of the century. In contrast, the numbers engaged in the textile and clothing industries had not increased as fast as the total occupied population in the pre-war decade, and actually decreased between 1911 and 1921. There is, of course, no justification for concluding that a change in the numbers engaged in an industry will be accompanied by a proportionate change in production. Owing to technical improvements, for example, the output of the textile trades rose faster before 1914 than the employment figures suggest; and at the same time production per head in coal-mining was decreasing. Yet the figures are sufficient to indicate how the importance of the staple industries as a whole was growing along with the expansion of overseas trade before 1914, and how the demand for munitions during the war enlarged still further the coal-mining, metal, engineering and chemical industries.

The geographical distribution of most of the trades falling within the three groups is indicative both of the period in which they rose to greatness and of their industrial function. They developed at the time when mineral fuel was being applied to the raising of steam for power and to the smelting of ores, and the manufacturers' choice of sites was necessarily limited to places where coal was cheap. This was true not only of the great staple trades, but of the minor manufactures, such as pottery, chemicals and glass, in which coal was an important raw material. Consequently, the industrial centre of gravity in the nineteenth century was in the north, where coal was abundant, and in 1921 about two-thirds of the 5½ million persons concerned with the staples were to be found north of the Trent. A

¹ *Survey of Industrial Relations*, p. 62.

² Committee on Industry and Trade, *Further Factors in Industrial and Commercial Efficiency*, pp. 24, 253.

large proportion of the remainder were in the neighbourhood of the coal-fields of the Midlands and of South Wales. The chance that most of the coal-fields were within easy reach of the sea, together with the dependence of the staple trades on foreign markets, and, in some cases, on foreign supplies of raw materials, led to an increasing concentration of industry round the ports. The proportion of the population within fifteen miles of the eleven leading seaports (excluding London) to the total population of Great Britain increased from 24.4 per cent in 1881 to 26.7 per cent in 1921.¹ Of all the great industrial areas, the Clyde Valley, Lancashire, the West Riding, the North-east Coast, South Wales, and the West Midlands, only the last is distant from the coast.²

It will be shown in succeeding chapters that particular branches of these great staples became concentrated in certain districts. The development of highly specialized industrial areas was, indeed, characteristic of the nineteenth century, and we have already seen how a town or district might reduce the range of its industrial interests in order to confine itself to trades yielding the highest returns. The growth of the foreign markets assisted this local specialization, and as long as demand was expanding, the "external economies of production" attending a highly concentrated industry were likely to promote this tendency. But it had been recognized that the fact that the established industries were carried on in specialized rather than in variegated areas would, in the event of their decay, make the redistribution of the country's resources among other trades more difficult. The strongly localized character of the great British industries, therefore, escaped criticism only so long as the demand for their products continued to expand. This question, however, must be considered later. Here it is sufficient to record that, in the period immediately before the First World War, the tendency for industries to become concentrated in the proximity of coal-mines was already being modified by new influences. Economies in the use of coal and the introduction of alternative sources of power were reducing the value of sites in the neighbourhood of the coal-fields. At the same time, improvements in urban transport were permitting employers to abandon the congested heart of the cities and to build factories in the suburbs, and the increasing mechanization

¹ *Ibid.*, p. 199.

² The omission of Greater London from this list must not cause us to overlook the fact that it is a great industrial, as well as a commercial, financial and administrative centre.

of industry was destroying the importance of certain types of skilled craftsmanship, such as could be obtained only in the larger industrial areas. Released from their dependence on coal and specialist labour centres, employers were seeking sites for factories in smaller towns and country districts, where rates were low and where there was space for the development of large-scale businesses. In determining the situation of producing units in many trades, the pull of the market or of cheap labour supplies was beginning to overcome the pull of the raw material. Thus a decentralizing movement had made its appearance in contrast with the nineteenth-century trend towards increased concentration at the coal supplies. On the whole, however, it was the newer trades which were most responsive to these new influences, and by 1914 the great staples were little affected. Apart from mere inertia, there were many factors to assist in maintaining the importance of the older centres. The transport services and the whole organization of commerce had been moulded to cater for their needs. All the heavy industries and those depending on imports of bulky raw materials were situated, as we have seen, in districts convenient for dealing with foreign markets. As long as the export trade of these industries continued to grow, the existing centres of population were likely to grow with them.

The great staples, taken as a whole, employed a higher proportion of male labour than the other industries of the country. The iron and steel, engineering, shipbuilding and coal-mining trades were staffed almost exclusively by men and boys, and only in the main processes in the textile industries were women in a majority. The nature of the labour force, the specialized character of much of the work, and the geographical concentration of these industries, had produced strong labour organizations and highly developed wage-bargaining methods. All the great exporting trades, with the exception of the woollen and worsted industry, had powerful trade unions. The engineering trade had provided in the Amalgamated Society of Engineers the model organization for skilled workers. The coal and iron and steel industries had, with varied success, pioneered the way in the provision of machinery for arbitration and conciliation. Wage problems were extremely difficult of solution in these industries. Most of the trades were highly unstable, partly because of their dependence on foreign markets, and partly because many of them were concerned with producers' goods. Consequently, in all of them, wages and employment, along with prices and profits, were

subject to violent fluctuations, which in some were the source of frequent disputes between capital and labour.

It is not surprising that observers tended to base their generalizations concerning British industry on data drawn from these great trades. With their rise and expansion Great Britain had become rich and powerful. Problems of large-scale production and marketing, of industrial relations, of unemployment and of trade fluctuations, were all presented here in their most clear-cut form. Fluctuations in the exports of iron and steel, coal, textiles and engineering products could serve, it seemed, as a measure of British economic prosperity and of British efficiency in relation to those of other nations. Since these industries were engaged, for the most part, on the bulk production of homogeneous commodities, it was easy to obtain figures of output, and it was thus possible to judge, with some exactitude, of any change in fortune. The very concentration of the trades brought them to the notice of the public; while the existence of strong trade unions and employers' federations, often organized on a national scale, made conflicts in them as spectacular as they were, in many instances, protracted. For these reasons it became usual to regard the state of the staple industries as indicative of the economic condition of Great Britain as a whole. This coloured the discussion of the misfortunes of those industries during the inter-war period and perhaps led to a wrong interpretation of events. It was realized only slowly that a time had arrived when Britain must change the direction of her industrial development and that a solution of her troubles was most likely to come, not from a recovery of her old industries, but from a redistribution of her resources among new ones. As this view came to be accepted, discussion turned on the conditions under which that redistribution was likely to be achieved.

II

Progress or Stagnation, 1919-39?

Before we consider the broad changes that actually occurred in the composition of British industry between 1919 and 1939, it may be useful to glance at the economic development of the world as a whole during that period. The post-war boom collapsed in the summer of 1920, and the succeeding depression spent itself by the end of 1922. From then until 1925 the countries that had been the

chief sufferers from the war were struggling to rehabilitate their economies and, under the leadership of Great Britain and the United States, to return to the system of international financial arrangements that had prevailed before 1914. By 1925 much had been done to restore stability. The currencies of most countries had been brought to order. Some variety of the gold standard had been re-established over a considerable part of the world, and a few years later that process was completed. A new equilibrium between costs and prices had apparently been established and the flow of capital from creditor to debtor countries resumed. Between 1913 and 1925 world production, as judged by the output of foodstuffs and raw materials, had increased to a greater extent than world population; the proportions were 16 per cent and 6 per cent respectively.¹ World trade, however, had recovered less rapidly than production, and important changes had occurred in the relative position of different regions. Production was much greater in North and South America, Asia and Africa than it had been before the war; but Europe had lagged behind and her proportion of total production and trade had fallen.²

The next period, from 1925 to 1929, saw a substantial increase in production, particularly in manufactures, in the world as a whole, and a still more rapid growth of trade. An outstanding feature of the period was the recovery by Europe of her former position as a producer and a trader; but in the light of subsequent events, it is evident that this recovery was insecurely based. The restoration of general financial stability and the resumption of foreign lending by the United Kingdom obscured certain fundamental weaknesses, and these were revealed in the Great Depression which began at the end of 1929 and led in 1931 to a financial crisis. This depression constitutes a dividing-line in the economic history of the world. It was marked not merely by a collapse of prices, especially of raw-material prices, and by a steep fall in industrial output, employment and international trade, but also by drastic changes in economic policy. In fact, the post-war attempt to reconstruct the economic life of the world on the foundations that had been laid in the nineteenth century was brought to ruin, and the autarchical policies which statesmen of liberal mind had tried to thwart during the nineteen-twenties now came to be accepted in most countries as inevitable. With the departure of the United Kingdom from the gold standard

¹ League of Nations, *The Course and Phases of the World Economic Depression*, p. 14.

² *Ibid.*, pp. 15-17.

in 1931, adherence to an international monetary standard ceased to be the general goal of policy, and managed currencies, frequently buttressed by such instruments as quantitative import restrictions and control over foreign exchange and capital movements, became usual. Governmental intervention, which in external economic affairs was directed primarily towards overcoming difficulties in balances of payments, spread to industry and internal trade, usually with the same object in view. In the industrial countries it was also inspired by a desire to find a cure for heavy unemployment, and in agricultural countries it derived support from the need to rescue producers from the effects of the collapse in prices. The system of economic liberalism was thus shattered over a large part of the world.

The phase of recovery from the Great Depression began in 1933 and persisted until the end of 1937. Production, prices and employment rose; but the recovery of international trade lagged behind. This can be explained mainly because the revival of production was everywhere associated with measures of policy designed to increase employment at home without much regard for international consequences. Autonomous policies of this kind necessarily had a restrictive effect on foreign trade. The phase of recovery gave place to a recession at the end of 1937, and this persisted until rearmament produced a "war-preparation boom" shortly before the outbreak of the Second World War.

Developments in British industry may be considered in relation to these world movements. From the post-war depression that ended in 1922 Great Britain passed into the period described by Professor Pigou as the "doldrums," which lasted throughout the rest of the twenties. These years were characterized by chronic depression in many of the basic industries, a persistent weakness in the export trade, and heavy unemployment among industrial workers, especially in certain localities. The failure of Great Britain to adjust herself to the changed circumstances of the post-war world must not, however, be exaggerated. By 1924 aggregate physical production was probably only 10 per cent less than in 1913, and the real income of the country had almost returned to its pre-war level.¹ From 1924 to 1929 there was a substantial advance. Aggregate physical production rose by at least 12 per cent, the output per head of those engaged in manufacturing and mining by 10 per cent, and the real income per "occupied" person (including the unemployed) in about the same

¹ Cf. A. C. Pigou, *op. cit.*, Part III, Chap. I.

proportion.¹ These general advances, however, concealed wide variations among the several industries. While growth had taken place in a large number of trades, including some that were very small at the beginning of the period, there was a steep decline in a few large basic industries, notably textiles, coal-mining and ship-building. It was this diversity of fortune among the several industries which led to the appearance of the depressed areas of the north and of South Wales at a time when the Midlands and the south were enjoying comparative prosperity.

These tendencies were paralleled in other countries. In the world as a whole electricity production greatly increased; the engineering trade grew, as a result of the expansion of the motor and electrical industries and the increasing mechanization of all manufacture; and the metal trades benefited by this progress. But the far-reaching changes in the technique of power generation proved detrimental to the coal trade, and the textile industries made only a slight growth, in spite of the increase in rayon and hosiery production. What is significant about the British position is that this country shared in an exaggerated degree in the depression which existed in some trades and failed to advance as much as the rest of the world in the industries which grew most rapidly.

The troubles of the staple British industries arose chiefly from their failure to regain their export markets. Up to the end of 1920 "the export market, as compared with pre-war years, recovered substantially less than the home market" in spite of the fact that during the post-war boom the *rate* of export expansion was greater than the *rate* of expansion of production as a whole.² During the slump exports fell, though hardly to the same extent as production. After 1922 there was a recovery, but in 1924-5 the volume of exports was still much less than before the war, and the proportion of British produce (agricultural and manufacturing output at ex-farm or ex-factory prices) that was exported then stood at about 25 per cent compared with over 30 per cent in 1907.³ The depression in exports at this time is not to be explained by the success of foreign competitors, for in 1924-5 the United Kingdom had a slightly higher share of the aggregate world export trade than in 1913, a relative improvement that was attributable to the disorganized condition of a leading rival, Germany. Up to this time, then, the depression in British exports could be regarded as part of a general

¹ C. Clarke, *National Income and Outlay*, p. 208.

² A. C. Pigou, *op. cit.*, p. 66.

³ *Ibid.*, p. 64.

decline in international trade, and it was reasonable to suppose that, with the return of financial stability to Europe, and as the immediate consequences of the war were overcome, a general revival of international trade in which the United Kingdom would share was likely to occur. This was certainly the view taken by expert observers at the time.¹ The general revival did, indeed, occur; but the United Kingdom was unable to obtain a sufficient proportion of the additional trade to lift her staple exporting industries out of the depression. The index of the volume of exports of British produce (base year = 1924), after falling in 1925-6, rose to 105 in 1928 and 108 in 1929. This, however, still left the volume of exports less than in 1913.²

The Great Depression led in Great Britain, as elsewhere, to a steep decline in industrial production; between 1929 and 1931 it amounted to about 16 per cent. Grievous as was the experience of this country, she suffered less severely than those industrial countries (e.g. Germany and the United States) which had made the greatest advances during the previous period. The decline in the volume of British exports, however, was exceptionally great. These losses were largely concentrated on the great staple exporting industries which had been depressed even in 1929, and consequently the condition of the areas in which these trades were located gravely deteriorated. The very heavy fall in British exports came about chiefly through the reduced demand from agricultural countries to which a large proportion of them was sent. The agricultural countries suffered from the collapse in raw-material prices and from the cessation of international lending, and so they were compelled to reduce their imports in order to balance their international accounts. On the other hand, the fall in these prices enabled Great Britain to maintain the volume of her imports of primary products and was in part responsible for the comparatively slight decline in many of the British trades that catered mainly for the home market.

After September 1931 the competitive position of British industry was improved by the depreciation of sterling and by the return of this country to protection. Yet British output as a whole made no substantial recovery until 1933 when the world began slowly to emerge from the depression. From then on, British industrial production rose steadily and by 1935 it had surpassed that of 1929. The peak was reached in 1937 when output was about a quarter greater than in 1929. The growth was, however, very unevenly spread over the

¹ A. Flux, "British Export Trade" in the *Economic Journal*, Vol. XXXVI, p. 554.

² See Index of Volume of U.K. Exports on page 48.

various industries. Among the factory industries the expansion occurred chiefly in the newer trades which had been growing during the twenties; but to a large extent it was associated with a boom in building, especially in house building. This building boom had a direct effect on numerous industries that supplied materials and furnishings, while of course the indirect effects of this new investment extended throughout the economy. The older staple industries, however, did not have much share in the recovery. With the exception of the iron and steel trade, this group of industries failed to regain the level of output reached in 1929, and in some of them the progressive decline continued. This failure was due mainly to their inability to recover the export trade lost during the years of the depression. Weakness in exports, however, was not confined to them. It is true that the foreign sales of some of the newer products rose, but those increases were insufficient to compensate for the heavy fall in the staple exports. In 1937, the best year of the thirties, the volume of British exports was only 83 per cent of the 1929 volume.

The depreciation of sterling after 1931 thus failed to bring about that revival in exports which had been expected by those who attributed Great Britain's weakness to the previous over-valuation of sterling. There were several reasons for this. The fall in sterling was followed by the widespread abandonment of the gold standard in the rest of the world, by further deflation in those countries that adhered to gold, and by an increase in the restrictions on international trade in the form of higher tariffs, import quotas and exchange control. Again, some British industries had failed to keep pace with those of other countries in technical improvements, and for this reason the relatively expensive British producers were still under-sold by their foreign competitors. It should be noted that while this *relative* decline in technical accomplishment could in some fields be attributed to further superiorities gained by countries that were already in the van of the general industrial advance, in other fields it occurred through the rapid rise in efficiency on the part of countries which had hitherto been relatively backward in technical methods. This latter consideration helps to explain the appearance of Japan as a competitor, for in that country there was a technical revolution in the cotton industry between 1927 and 1932 and, subsequently, a rise from low levels of technical efficiency in rayon, wool textiles and the metallurgical trades.¹

¹ See G. C. Allen, "Japanese Industry: Its Organization and Development to 1937" in E. B. Schumpeter (Ed.), *The Industrialization of Japan and Manchukuo*, Ch. XIX.

Meanwhile, policy was being directed to the support of the depressed industries, not merely by giving them the protection of higher tariffs and quantitative restrictions on competitive imports, but also by the introduction of measures to increase the producers' own control over their markets. In overseas markets these industries were assisted both by the preferences granted by Empire countries as a result of the Ottawa agreements of 1932, and by a series of bilateral commercial treaties which secured favourable conditions for certain British exports in particular foreign markets. For instance, in the course of 1933 and 1934, several bilateral trade agreements were made between the United Kingdom and the Scandinavian and Baltic countries. The United Kingdom usually undertook to refrain from imposing more onerous restrictions than those already in force on imports from countries with which the agreements were made, or to grant a certain share of the total imports of particular products to their traders. In return, these countries undertook to buy from the United Kingdom an agreed proportion of their imports of coal. The British Government was able to make satisfactory bargains with these countries because the latter possessed a favourable trade balance with the United Kingdom, and because their sales to the British market, which formed a large part of their agricultural exports, were being threatened by the new British agricultural policy. The coal industry derived some benefit from these arrangements, and the exports from the North-east Coast were favourably affected by them. Another trade agreement which was made with Poland in 1935 led to reductions in tariffs on British textiles, and the important agreement between the United Kingdom and the United States in 1938 provided, *inter alia*, for substantial decreases in the American textile duties. The British Government, in negotiating these agreements, clearly had in mind the most depressed among the export trades. But the effectiveness of its action was seriously limited because the Government was precluded from granting any substantial concessions to the food-exporting countries, partly because of its own agricultural policy and partly because of the inter-Empire arrangements made at Ottawa. Trade negotiations, for example, with the Argentine, were hampered through these causes. In the Colonial markets the policy of assisting the exports of textiles led to the institution of quotas on foreign textile imports. This was an attempt to curb Japanese competition.

In some industries, notably agriculture and shipping, assistance in the form of subsidies was granted. In the home market the

Government also lent its support to monopolistic arrangements by which the financial position of the industry could be improved. The cartelization of the coal industry under Part I of the Coal Mines Act 1930, the establishment in the same industry of central selling schemes in 1936, the strengthening of monopoly in the iron and steel industry after the formation of the British Iron and Steel Federation in 1932, the measures, which culminated in the Cotton Industry (Reorganization) Act of 1939, to reduce competition in the cotton industry, the support given to so-called rationalization schemes in the shipbuilding, tinplate, wool-combing and other industries, the monopolistic producers' boards set up under the Agricultural Marketing Acts, the restriction on road competition with the railways imposed under the Road and Rail Traffic Act of 1933; these are all examples of the retreat from competition in British industry during the thirties and of the deliberate Government policy of fostering that movement. Some of them will be discussed in subsequent chapters. The policy doubtless resulted in raising receipts per unit of output in the depressed British trades; but they did little to relieve unemployment, or to promote that redistribution of resources which the changed economic position of the country required. Some of the measures probably had a most disadvantageous effect both on the efficiency of particular industries and on the flexibility of the economy as a whole.

Thus, the more obvious features of the industrial history of the period from 1914 to 1939 were, first, the decline in the great staple industries in which Great Britain had specialized in the nineteenth century, a decline that was bound up with the loss of export markets, and, second, the failure of Great Britain to obtain a sufficient share of the new and developing industries to compensate her for losses in the old and to occupy the labour displaced from them. Yet, although this was a period of industrial malaise, it would be a mistake to conclude that it was one of stagnation. The volume of industrial production was probably 80 per cent higher in 1937 than it had been in 1907, and real income per head about 30 per cent higher. It is true that the improvement in Great Britain's terms of trade was partly responsible for this rise in the standard of life, and also that the massive legacy from the past in the form of accumulated foreign assets, which were drawn upon during the thirties, provided a cushion against the shocks of the period. But the main cause was the improvement in industrial efficiency which, though not so great as in several foreign countries, was substantial. Technical

advance was rapid, not merely in the new industries, such as rayon, electrical engineering and motor manufacture, but also in the older industries such as steel, mechanical and marine engineering, chemical and shipbuilding. The mechanization of processes was widely extended. Industrial scientific research, which was more vigorously pursued than ever before in individual firms, universities and associations sponsored by the Government, led to the emergence of many new varieties of product, especially in the chemical and metallurgical industries, and to improvements in the quality, or to the cheapening, of old ones. There were advances, also, in managerial technique and in the methods of organizing industrial establishments. The result was that the output per worker employed was much higher in 1939 than in 1913,¹ although some part of the benefits of that improvement was thrown away through failure to solve the unemployment problem. Thus the instability of the period did not prevent substantial economic progress.

That the staple industries should decline was probably inevitable, for British specialization on their products was the result of the system of international exchange characteristic of a particular stage in world development, a stage in which the "newer" countries were developing their natural resources and were importing capital from the older countries to enable them to do so. Once this stage had been passed, and once customer-countries had acquired technical skill and experience, Great Britain was bound to lose her predominant position as a supplier of the staple manufactured goods. The war of 1914-18 made the change more rapid than it would otherwise have been, since it stimulated manufacturing in countries deprived of their normal imports of industrial products. Yet the war was not the only accelerating force at work. For instance, the rate of increase among Western populations had begun to fall. This, in spite of the rise in income per head in those countries, necessarily retarded the growth in the demand for foodstuffs and for raw materials required to satisfy primary needs, for the necessities of life have a low income-elasticity of demand. In the inter-war period, the comparatively slow growth in the demand for these primary products brought depression to agricultural countries, compelled them to reduce their imports of manufactured goods and

¹ It is estimated that output *per wage-earner* (in the manufacturing, mining, building and public utility industries) was 47 per cent higher in 1937 than in 1907 and that output per man-hour was 65 per cent higher. See L. Rostas, *Comparative Productivity in British and American Industry*, p. 49.

stimulated their own industrialization. This transference to industry on their part was made all the more necessary by the extensive application at this time of scientific methods to agriculture, for the result was that a given quantity of raw materials could be produced by a smaller number of agricultural workers than had previously been needed.

The steep decline in incomes from agriculture during the World Depression led to a further reduction in the purchases of manufactured imports by primary producing countries and often to an extension of their own manufacturing capacity. As these countries were not usually capable of setting up branches of the newer industries, they necessarily turned to the production of the staple manufactures which they had previously imported. The spread of immigration restrictions also exerted an influence by forcing foreign countries in an early stage of economic development to establish manufacturing capacity for the purpose of occupying displaced agricultural workers who, under conditions of *laissez-passer*, might have moved to high-wage countries. When these nations continued to rely on imports, they were obliged to purchase cheaper classes of goods than those previously imported, and this change in their demand was to the disadvantage of manufacturing nations incapable of adjusting themselves to the new class of trade. Indications have already been given that certain British industries suffered with great severity from these developments. Britain's export trade as a whole was necessarily affected more adversely than was the trade of other industrial nations because an exceptionally large proportion of it went to agricultural peoples. Nations accustomed mainly to supplying other industrial areas were not injured in the same degree.¹

At the same time there were other changes hostile to the British staple exports. Technical discoveries brought substitutes for certain manufactured goods in the production of which Great Britain had marked advantages (e.g. acid steel and forge and foundry iron), while the replacement of coal by oil for ship-propulsion dealt a heavy blow at another great British trade. Further, the demand for certain engineering products in which this country specialized (e.g. railway equipment) was reduced by the slowing up of railway development overseas. In some cases technical progress led to the provision by foreign producers of cheaper qualities of goods than

¹ League of Nations, *Memorandum on Production and Trade, 1925 to 1929/30*, p. 42. For example, in 1929 Germany sent 74 per cent of her exports to other European countries, Britain only 35 per cent.

those which the British industry was organized to supply ; this is true of certain cotton textiles. Thus, the markets which Great Britain served and also the types of goods which she supplied suffered particularly severe damage on account of the changes of the inter-war period.

In the past, when her established position was threatened, Great Britain had been able to maintain her exports by shifting to new markets and new products, and it might have been expected that she would have repeated this process. The cheapening of primary products made it possible for industrial populations to enlarge their expenditure on other goods, and so brought about an expansion in international trade in articles which met other than basic needs. Examples are motor vehicles, electrical apparatus and rayon. Now it is true that Great Britain raised her export of these goods, but she did not succeed in gaining a place in these newer markets equivalent to that which she had formerly enjoyed in the older staples. It was other countries that obtained the lion's share in them. The very intensity of Britain's specialization on the older products probably increased her difficulty in adjusting herself to production of the new. An inquiry that covered a very high proportion of the manufactured exports of the three leading exporting countries in 1929, showed that over half the exports of Great Britain included in the sample consisted of goods in which total world trade had increased, between 1913 and 1929, by less than 75 per cent (in current gold values) and that only about one-twentieth consisted of goods in which world trade had risen by over 150 per cent. In the case of the United States, on the other hand, only 17 per cent of her manufactured exports were in the former category and nearly 29 per cent in the latter.¹ It was the relative stagnation of Great Britain in the newer trades rather than the decline of her old industries that was the main cause for disquiet.

It may, of course, be argued that the redistribution of resources that was required of Great Britain involved a contraction of her exports, for the cheapening of her imports and the drying-up of opportunities for profitable foreign investment meant that a higher proportion of her output could properly be diverted to the home market. There is some force in the argument, for this is indeed what happened.² But the unbalanced state of Great Britain's inter-

¹ See A. J. Brown, *Applied Economics*, p. 200, where the results of this inquiry are quoted.

² The proportion of the total industrial production that was exported has been estimated at 27 per cent in 1924, 22 per cent in 1930, 17 per cent in 1935 and 15 per cent in 1938. Cf. H. Clay, "The Place of Exports in British Industry after the War" in the *Economic Journal*, June-September 1942.

national accounts in the later thirties shows that it cannot be used to justify the whole of the export contraction which took place; while the existence of heavy chronic unemployment throughout the period is itself a sufficient demonstration that the adaptation of the British economy to its changed environment had not been successfully achieved.

III

War and Inflation, 1939-58

The Second World War interrupted the trends that have been described; for industrial resources had to be transferred on a huge scale from peace-time to war-time activity. Broadly speaking, what had happened from 1914 to 1918 in the industrial sphere was repeated between 1939 and 1945, although the extent of the transformation of the economy during the Second World War was much greater than during the First. This is no place to describe the creation of the war economy and we must be content with a brief indication of the war's impact upon industry. The best measure of the economic changes that occurred is given by the estimates of national expenditure before the war and at the peak of the war effort. In 1938 expenditure by the public authorities on goods and services (including the pay of the armed forces) represented about one-fifth of the net national income. During the war this expenditure rose to over three-fifths of the net national income; direct war expenditure alone was 56 per cent of it.¹ The effect on man-power distribution was also very remarkable, although the available statistical evidence does not reveal the whole story, since many firms in the civilian goods trades used their capacity for making goods which were very different from their peace-time products. To a large extent the war reversed the inter-war tendency for the heavy industries to give place to the lighter consumption goods trades. There was a revival in shipbuilding, heavy engineering, agriculture and several previously depressed branches of the iron and steel trade; while the formerly expanding industries, such as food, drink and tobacco, furniture, building, hosiery, distribution, and the "service" industries in general, contracted. There were some of the older staples, however, for which the war brought further decline, namely cotton and wool textiles

¹ *An Analysis of the Sources of War Finances and Estimates of the National Income and Expenditure in the Years 1938 to 1944* (Cmd. 6623), p. 16.

and coal-mining. In some of the newer industries, such as motor manufacture, the war led to the expansion of the constituent firms; but the type of product changed completely and the pre-war markets could no longer be served. The export trade became insignificant, and towards the end of the war its volume (including munitions exports) was only about one-third of that of 1938. Meanwhile, the equipment and working capital of the peace-time industries were run down, recruitment and training for many of them were interrupted, and with the tightening of controls and the centralization of economic initiative in the Government, entrepreneurial functions passed from business men to Ministers and civil servants. The major problem of pre-war days, general unemployment, disappeared, and with the revival of the heavy industries and the diversion of new productive capacity to the formerly depressed, or Special areas, localized unemployment went with it.

When the war came to an end, the United Kingdom was faced not merely with transitional problems, such as the redeployment of her labour force, the restoration of her industrial equipment and working capital, and the recapture of foreign markets, but also with the long-term problems that arose out of her weakened economic position. She had been cushioned against the difficulties of the thirties by her receipts from foreign investments and by her favourable terms of trade with primary producers. Both these advantages disappeared. She had realized a large part of her foreign assets during the war and, because of the general rise in world prices, the real value of many of the remaining investments had fallen. At the same time she had acquired a heavy volume of indebtedness to foreign countries, largely in the form of sterling balances accumulated during the war, and the terms of trade had moved against her. Further, for the time being at any rate, invisible exports, such as shipping and financial services, declined, and the Government had heavy payments to make overseas. The country's economic position was thus threatened much more seriously than in 1931 through inability to balance her international accounts, and it soon became apparent that a very large increase in commodity exports was essential if the standard of life were not to fall. The problem was not merely that of enlarging previous foreign markets; a redirection of trade was necessary. Before the war the British import surplus with North America was settled in part by the British export surplus to other regions. The war, however, had brought about a breakdown of the multilateral trading system. Because of the economic

disorganization in many supplying countries, Great Britain had become both more dependent upon America for imports and also less able to pay for those imports by exports to other parts of the world. The resulting dollar gap was bridged only by financial aid from the United States.

How did the British economy respond to the challenge of these new circumstances? The redistribution of man-power immediately after the war was effected smoothly, and from then until 1958, in striking contrast to the twenties, a condition of "full employment" was maintained. Industrial investment throughout this period was at a considerably higher rate than before the war, even though it had to compete with much non-industrial investment (e.g. housing) sponsored by the government.¹ The index of production (1938 = 100), which in 1947 was 104 (about the same as in 1937), rose to 156 in 1957; this represented for the post-war years a considerably higher rate of increase a year than for the period 1924-37. The export trade soon returned to its pre-war volume and then rose well above it. In 1957 it was probably about 80 per cent greater than in 1937, and with the restoration of the mercantile marine and of international financial business, the earnings from invisible exports also recovered. What is more, the revival both in production and exports was achieved without such violent fluctuations in activity as had occurred in the inter-war period. Up to the end of 1955 production and exports increased in every year, except during the short-lived recession of 1952 which was serious only for the textile industry. Some trades, e.g. iron and steel and shipbuilding, which in the past had shown themselves very susceptible to cyclical fluctuations, enjoyed a period of sustained prosperity unmatched in their previous history.

Yet, despite these notable achievements, the post-war period brought grave economic and industrial anxieties. Most of them had their root in inflation. Prices rose on an average by between 4 and 5 per cent per annum, and between 1946 and 1957 the aggregate increase amounted to 65 per cent, an unprecedented rise for any peace-time decade within the last century.² The main cause was the maintenance of an abnormally high level of demand attributable,

¹ In 1938 gross fixed capital formation (excluding dwellings) represented 8.5 per cent of the gross domestic product, and net fixed capital formation represented 3.2 per cent of the national income at market prices. Between 1948 and 1957 the corresponding percentages ranged between 9.4 and 12.4 (gross) and between 3.4 and 5.8 (net).

² That is, unprecedented in Great Britain. Council on Prices, Productivity and Incomes, *First Report*, p. 4.

during the early post-war years, to attempts to "repair the damage and deterioration caused by the war, to restore standards of consumption and to improve the social services", and, after 1950, to heavy expenditure on rearmament and to high investment, both private and public.¹ The most obvious result of the inflation was the recurrence of balance of payments crises which in 1949 led to a devaluation of sterling and on several occasions to the sudden imposition of various stringent measures of control, monetary, fiscal and physical. For the industrial sector of the economy inflation led to serious waste and to a misdirection of resources. The stimulus to efficiency that a competitive system normally provides was weakened, and the measures taken to curb the inflation, including heavy taxation, reduced the reward to exceptional effort. Economic efficiency, it should be remembered, refers not merely to productivity within particular industries, but also to the distribution of resources over the various uses to which they can be put. "Over-full" employment, which was the natural accompaniment to inflation, created obstacles to the redistribution of labour in accordance with changes in demand and technique. At the same time labour productivity in many industries was adversely affected by shortages of skilled workers and, in the early post-war years, by the absence of adequate working stocks of materials which led to interruptions in production. Deliveries were often seriously delayed.

These circumstances explain, in part, why the British industrial achievement, though considerable, compares unfavourably with that of several other countries. Both on the Continent and in the United States production grew faster than here and, what was more serious for future progress, the determination of the British to consume a high proportion of their current output meant that industrial investment as a proportion of national income was lower in this than in several other industrial countries. It is significant that after 1955 the upward trend of British industrial production was checked, whereas in most other countries the advance continued until the end of 1957. Comparisons of labour productivity in recent years are also unfavourable to Great Britain. For example, between 1953 and 1957 output per man-hour in manufacturing industry rose by 30 per cent in both Germany and France, but by only about 9 per cent in Great Britain.² Thus British economic policy after 1945 succeeded in avoiding heavy unemployment, but only by measures that hampered efficiency in other respects.

¹ *Ibid.*, p. 24.

² Based on figures published by O.E.E.C.

The deficiencies must not be over-stressed, for British industry displayed resource and initiative in the development of new products and contributed conspicuously towards improved methods and technical advances. In the post-war period Great Britain was a pioneer in the aircraft industry and in the application of atomic power to peace-time uses. She built up a large oil-refining industry and several important trades based on the derivatives of oil refining. She developed new branches of the engineering, electrical, chemical and textile trades. In general, the industrial trends of the inter-war years in respect of the relative importance of the major industrial groups persisted. The engineering, metal and chemical industries grew very substantially, while the older textiles and coal mining suffered a further absolute decline. Yet in some branches of the economy, pre-war tendencies were reversed and certain once chronically depressed industries were restored to prosperity. This was true of pig-iron production and of shipbuilding. The figures of production and man-power distribution given in the tables on pages 46-7 bring out the chief alterations in the relative importance of the different industries.

In the early post-war years the British export trade was favoured not only by the generally buoyant demand for manufactured goods, but also by the absence of two of the major competitors from world markets, namely Germany and Japan. The British share of the world export trade in manufactures consequently rose to 25.6 per cent in 1950 compared with 18.6 per cent in 1936-8. With the return of these competitors to international trade, the British share declined and in 1957 it was 18.3 per cent. This relative fall, however, was consistent with an almost continuous rise in the absolute volume. Meanwhile, the contribution of the various industries to the export trade underwent important changes. The engineering and metal industries greatly increased their share of the total, and certain branches of those industries which had previously played little part in international trade became leading exporters. On the other hand, the contribution of textiles and coal fell absolutely as well as relatively. There were changes also in the geographical distribution of sales. The Commonwealth's importance as a market increased; in 1955-7 it took 48 per cent of the total British exports compared with 43 per cent in 1935-8. Within the Commonwealth, the shares of the different countries showed a considerable alteration; for example the Indian Subcontinent and South Africa declined, while the Colonies became more important as customers. The United States, which in 1955-7

took 7 per cent of total British exports, and Western Europe and its dependencies, which took 26 per cent, slightly increased their shares. South America, Eastern Europe and East Asia all became less valuable as markets.

The changes that occurred in the direction of British industrial development were accompanied by equally important changes in economic policy. Many of the war-time controls survived into the early post-war period and were even supplemented by others. Up to the early fifties price controls over the basic foodstuffs and many other classes of consumer goods remained. Most types of food were then rationed, the utility clothing scheme continued, nearly all house building was to the orders of local authorities and other forms of building were strictly limited. The government was still the importer of a wide range of raw materials and foodstuffs, and several types of exports were subject to licence or other forms of control. Thus the British economy was still obedient to a large measure of centralized direction. During the period from 1951 to 1958 this elaborate structure was dismantled. Quantitative import controls disappeared; State importing virtually ceased; and the organized commodity markets were re-established. Price controls, rationing and building licences were abolished and rent control relaxed. Foreign exchange controls became progressively milder, and although in 1958 the raising of new capital by private industry was still restricted, by then the government had come to rely mainly on monetary and fiscal measures to achieve its purposes rather than on physical controls.

Nevertheless, the government's influence over industry remained more powerful and wide-ranging than in pre-war days. For one thing, the size of the public sector had been much enlarged. In the early post-war years the government nationalized a number of basic industries and undertakings; these, by 1951 included the railways, London passenger transport, long-distance transport of goods by road, electricity supply, gas supply, coal-mining and ancillary undertakings, cable and wireless, air services, iron and steel, raw cotton marketing and the Bank of England. After 1951 iron and steel, raw cotton marketing and most of the road transport were returned to private enterprise; but this left over two million persons employed by the nationalized industries, about a tenth of the total employed population. It is true that many of these industries had long been subject to some form of public control and that for them nationalization meant a change in ownership and in the form of administration rather than a transference from free competition to public

monopoly. Yet, in the fields of pricing, capital supply, wages and industrial relations, nationalization introduced new factors which had a profound effect on the functioning of the whole economy. Some of these effects will be considered in subsequent chapters.

To a number of trades nationalization, of course, brought a greater concentration of ownership and control. In the private sector, however, it is doubtful if concentration increased,¹ while the suppression of competition by agreements and cartels, to which industrialists directed much effort during the thirties, encountered opposition from the government's policy towards monopoly and restrictive practices. Here there was a reversal of aims. In the years of depression before the war the government actively encouraged the cartelization of many of the staple industries. A change in policy was foreshadowed in the White Paper on *Employment Policy* in 1944, where it was argued that "full employment" might well be frustrated by restrictions designed to limit output and keep up prices. This change of view received expression in the Monopolies and Restrictive Practices Act of 1948. A Commission was set up to investigate industries and practices referred to it by the government and to propose remedies when the "things done" by a monopolist were judged to be contrary to the public interest. The recommendations of the Commission, contained in some twenty Reports, led to the abandonment of various types of restrictive practices in the industries surveyed, and it is probable that its activities resulted in the modification, over a wide range of industry, of the practices to which the Commission took the strongest objection. In 1956 the Restrictive Practices Act was passed. This prohibited the collective enforcement of resale price maintenance (although it made provision for the legal enforcement of *individual* resale price maintenance).² It also required the registration of a wide range of restrictive agreements and set up a Restrictive Practices Court to judge cases brought before it by the Registrar. The onus of showing that such arrangements were not contrary to the public interest was placed upon those who practised them, by reference to certain criteria laid down in the Act. Thus, in manufacturing industry and in trade, cartels are now on the defensive. This more benevolent attitude towards competition has been demonstrated in other ways. Since the de-nationalization of road transport, the

¹ Cf. P. E. Hart and S. J. Prais, "The Analysis of Business Concentration: A Statistical Approach" in *Journal of the Royal Statistical Society*, Part 2, 1956.

² On this question, see the Commission's report; *Collective Discrimination* (Cmd. 9504, 1955).

government has freed the railways from the legislative restraints which formerly impeded them in their rivalry with the road operators, and it looks to competition rather than to centralized administration to determine the allocation of traffic between road and rail.¹

IV

The Location of Industry

One of the most striking features of the period after 1920 was the contrast between the prosperity of the south and Midlands and the chronic depression suffered by the north, South Wales and Scotland. Between 1923 and 1938 the proportion of the country's insured workers (in employment) in the southern half of the country rose from 48 per cent to 55 per cent. A further indication of the movement that occurred is given by comparing the rates of change in the number of insured workers in different parts of the country. These are shown in the following table.

PERCENTAGE CHANGES IN NUMBER OF
INSURED WORKERS, 1923-37

Great Britain	...	...	...	...	...	+22.3
London and Home Counties	...	...	...	...	...	+42.7
Midland Counties	...	...	...	...	...	+28.2
West Riding, Nottinghamshire and Derbyshire	...	...	...	...	...	+15.0
Mid-Scotland	...	...	...	...	...	+ 9.5
Lancashire	...	...	...	...	...	+ 7.6
Northumberland and Durham	...	...	...	...	...	+ 4.7
Glamorgan and Monmouth	...	...	...	...	...	- 4.3

Throughout the period the number of insured persons unemployed, in years of general prosperity and of depression alike, was far heavier in the north and in South Wales than in the Midlands and south.

The cause of the contrast between the fortunes of these regions was that the new and expanding industries were, for the most part, growing up in areas other than those in which the declining industries were located. South Wales, the North-east Coast, Clydeside and Lanarkshire, and parts of Lancashire, were highly specialized to the staple industries that were decaying during the twenties and

¹ For further information about recent changes in economic policy and industrial organization, see G. C. Allen, "The British Economy" in R. Frei, *Economic Systems of the West*, Vol. I.

thirties—coal-mining, shipbuilding, marine engineering and cotton. In the iron and steel industry also, the sections located in the north of England and in Scotland suffered both from the effects of the general depression in which the industry was involved for most of this period, and also from locational changes presently to be described. Meanwhile, the newer industries were developing most rapidly in the south (especially Greater London and the south-east), and in the Midlands; examples are to be found in the motor, electrical, rubber, manufactured foodstuffs, furniture and hosiery industries, and in a host of small miscellaneous trades. The south and Midlands benefited by the fact that, before these developments occurred, they already possessed to a greater extent than the north a nucleus of these industries or, in some cases, particular branches of industry which could easily adapt themselves to the manufacture of the new products. The necessity for considering the “initial position” of the different regions in any analysis of the changes that occurred in them during these two decades is well brought out by the case of the “service” trades.¹ The south of England already had a disproportionately large share of these in the early twenties, and as they were among the trades that grew most rapidly in subsequent years, it was the south that obtained the greatest benefit from their expansion.

Powerful economic forces were, of course, responsible for determining both the “initial position” of the various areas and their subsequent industrial history. The industries in decay were, for the most part, the heavy industries, which are necessarily located near the site of raw-material supplies, while the newer industries were mainly those which produce light finished consumer goods and tend to be drawn to the neighbourhood of the largest consumer markets, or to centres with the best distributing facilities. This naturally worked in favour of the London area in the circumstances of the twenties and thirties. Technical changes were also significant. The decreasing importance of raw coal as a fuel for industry, and the increased use of electricity for motive power, reduced the value of sites near coal-fields. It was partly because of the economies effected in the use of coal for smelting that new branches of the iron and steel industry developed in the East Midlands rather than in the north of England.

Two other reasons for the southward trend of industry were put

¹ Cf. S. R. Dennison, *The Location of Industry and the Depressed Areas*, pp. 148-9.

forward. One was that local rates were likely to be higher in the older industrial areas, especially if they were suffering from distress caused by prolonged depression, than in newly developed areas. Thus, it was argued, localized depression was likely to perpetuate itself, since industrialists seeking a site for new enterprise avoided the former areas. Rates do not form, however, a significant proportion of the costs in most industries, and after the Derating Act of 1929 the differential burden became very small indeed. So it is doubtful if the rating system had any important effect. The other reason offered was that employers believed that labour in the older industrial centres was either unsuitable for manning the new light industries or unmanageable. There was probably little truth in either of these contentions; but if employers believed them, then their decisions were doubtless influenced accordingly. Moreover, since in many of the new industries manufacturers had a greater latitude in their choice of sites than those in the older, heavy industries, they were likely to shun areas over which prolonged depression had cast a gloom and to which it had given a legacy of squalor and bitterness. Changes in the organization of industry also had some effect. The development of great combines, with an administration centred in London, made it convenient to set up new plants in places which could easily be reached from the capital. While this certainly influenced the location of some new factories, it could hardly be classed among the leading causes of these locational changes.

The difficulties of industrial transition were increased by this growth of new industries in districts remote from the older centres. Some unemployment must always follow from structural change. Yet, provided that new trades spring up in the neighbourhood of the old ones, heavy and prolonged unemployment may be avoided, because the latter cease to recruit new labour while the new trades take up the juveniles who are just entering industry. The movement of adults to new occupations is also facilitated. But the location of the new trades in the inter-war years prevented this easy transference from taking place. It is true that migration from South Wales and the North-east Coast to Greater London and the Midlands occurred on a large scale;¹ but this redistribution of the population was insufficient to relieve the condition of the depressed areas. Juveniles

¹ It is estimated that 160,000 persons migrated from South Wales and 130,000 from the north-eastern counties between 1931 and 1939. Between 1921 and 1937 500,000 persons migrated to the London area. See White Paper on the *Distribution of Industry* (1948), pp. 7-8.

still continued to enter the mining industry in the Welsh valleys, where their future prospects were very bleak, at a time when growing industries in other parts of the country were suffering from a shortage of young labour.

The Government made several attempts to deal with the situation. At first its efforts were directed towards encouraging and assisting migration from the depressed to the prosperous centres. Later it adopted a policy of bringing new industries to the former. By the Special Areas Act of 1934, and by subsequent legislation, certain areas were selected for the application of various types of financial assistance, and Commissioners were appointed to administer these measures. Work was put in hand to make these "Special Areas" more attractive to industrialists. For instance, harbours and communications were improved, and Government Trading Estates established on which factories were built and let to manufacturers. A considerable number of firms engaged in the lighter industries were induced to occupy these factories in the years just before the war; many of them were started by refugees from Europe. Further, the Special Areas Reconstruction Association was formed, under Government guarantees, to make loans to manufacturers in these areas, and other financial assistance, both private and official, was given. The condition of the areas certainly improved during the years immediately before the Second World War, although rearmament rather than these special measures was mainly responsible. During the war itself the areas became very busy, partly because of the heavy demands made on their existing industries, and partly because many new kinds of production were diverted to them. Localized unemployment virtually disappeared.

The Government, in planning for reconstruction, was determined to prevent the recurrence of the pre-war problem, and the White Paper on *Employment Policy* of 1944 gave prominence to measures for dealing with the danger of localized unemployment. In 1945 the Distribution of Industry Act was passed and this was directed specially towards the problems of the formerly depressed areas. Two years later it was followed by the Town and Country Planning Act which contained clauses relevant to the same policy. Under the 1945 Act certain areas were scheduled as Development Areas. These were substantially the former Special Areas with enlarged boundaries, and later other areas were included in the schedule.¹

¹ The Development Areas now comprise the following: North-eastern, West Cumberland, South Wales and Monmouth, Scottish Industrial Belt and

The Government was given powers, similar to those conferred by the Special Areas legislation, to assist in the development of new industries. These powers enabled the Board of Trade to build factories in the areas and to make loans to industrial estate companies engaged in the provision of premises. The Government was also empowered to improve local services, such as transport, power and housing, to reclaim derelict land, and to give financial assistance to undertakings already established in the areas. Further, all industrialists were required to notify the Board of Trade if they intended to erect buildings beyond a certain size. The original Bill also contained a clause which conferred on that Department authority to prohibit any new factory building in certain areas which were considered as unsuitable for further industrial development. This clause was dropped during the passage of the Bill through Parliament; but since the Government possessed under its emergency legislation the power to license building, the same purpose was achieved by other means. Later, the Town and Country Planning Act of 1947 provided that the consent of the Planning Authority was required in respect of new industrial building, and that this consent was to be given only if the Board of Trade certified that the "development in question [could] be carried out consistently with the proper distribution of industry."¹

It was realized that the period of post-war reconstruction was one in which industry would be far more mobile than in normal times, and that, in consequence, the opportunities for influencing location would be exceptionally numerous. So the Government was able to use its powers extensively and effectively. The pre-war trading estates were enlarged, new estates were started, and factories were built by the Government for occupation by private firms. War-time munitions factories located in the Development Areas were either retained in production or were converted into industrial estates, and financial assistance to firms in those areas was generously bestowed. Private firms readily obtained permission to build factories there at a time when in other parts of the country industrial building was strictly limited. In these and other ways the policy was vigorously pursued.

Dundee, Wrexham, South Lancashire, North-east Lancashire, Merseyside, and the Scottish Highlands. In 1958 the government took powers to assist localities outside the Development Areas that might be exposed to the danger of serious unemployment.

¹ White Paper on *The Distribution of Industry*, p. 12.

The main results were achieved in the early post-war years. Between 1945 and 1948 inclusive some 52 per cent of the total industrial building completed took place in the Development Areas, whereas between 1949 and 1955 the proportion was only 28 per cent.¹ This reduction occurred partly because, with the abandonment of certain controls, some of the weapons of persuasion lost their force, but mainly because in later years restrictions on industrial building were not rigorously applied to firms that produced armaments or goods for export. Moreover, although unemployment was proportionately higher in the Development Areas during this period than in the country as a whole, it remained very low everywhere. One of the main purposes of the policy seemed, therefore, to have been achieved. On the other hand, while the policy may have restrained the southward drift of population, it was by no means successful in preventing it.

Most of the new industry introduced into the Development Areas was concerned with consumption goods, and the former extreme dependence of those areas upon capital goods has consequently been reduced, in spite of the great activity enjoyed by the heavy industries since the war. This diversification of the hitherto highly specialized areas is, of course, a necessary part of the whole policy. It is hoped not merely that diversification will reduce the liability of the areas to the extreme fluctuations in activity to which capital goods industries are exposed, but also that, by giving the areas contact at numerous points with the country's industry, it will make secular adjustments in the scope of their interests easier to bring about than formerly. Yet the creation of a "diversified economic structure is bound to be a slow process," as the Government itself has stated.² Indeed, it may be doubted whether highly diversified areas (comparable, for example, with the Birmingham area) can be created by official measures, without serious damage to efficiency, in places which have owed their development to their advantages for a few heavy trades, even though the intense specialization of the past may usefully be modified. It must be remembered, moreover, that if the policy has so far been reasonably successful, it has been applied in exceptionally favourable circumstances. The conditions of full employment in the economy as a whole have made industrialists

¹ Even this proportion must be regarded as high, for the Development Areas contain less than a fifth of the total number of insured workers in manufacturing industry.

² White Paper on the *Distribution of Industry*, p. 21.

amenable to persuasion in the selection of new sites, since they have been prepared to go where labour is available. Further, inflation has meant that firms have been operating in conditions in which they have not had to pay so much regard as in pre-war days to the question of the comparative costs of production at different locations. It has yet to be shown whether the Development Areas are as suitable as other areas for the manufacture and distribution of the types of goods for which the new factories have been established, and whether the new enterprises will survive a period of less active trade.

Intervention by the Government in the field of locational decisions must be regarded as of great significance for the future efficiency of British industry. Although the importance of location varies widely from product to product, the site of a plant is seldom a matter of indifference from the standpoint of costs. If the present policy were to have the effect of raising British costs in the long run, it would be difficult to justify it. It is true that, because of the divergence between social and private net costs under conditions of *laissez-faire*, industries do not always become ideally located, and that in principle this provides the grounds for intervention. Yet an official policy designed to preserve a given level of activity in an area, and carried out by coercing or persuading industrialists to site their plants in places other than those which they themselves would have chosen, has its own dangers. For the Government to pit its judgment against that of an industrialist in the selection of his site presupposes a superiority in calculation and foresight which it does not always possess. To argue that the Government is likely to judge more correctly than the private entrepreneur because it is able to take account of the *social* costs of alternative decisions is to ignore the extreme difficulty of measuring such costs. In the past, industrial areas have developed, like industries themselves, by processes of organic growth. The results have not always been satisfactory, and it is reasonable that the State should wish to guide those processes by reference to criteria which, though relevant to the efficient use of resources as a whole, are not likely to be present in the minds of particular industrialists. But the execution of a policy of this sort calls for great wisdom on the part of politicians and officials, whose decisions, it has to be recognized, are liable to be determined by considerations other than those of economic efficiency. This will remain true even if, as has been suggested, the policy should be modified so as to embrace purposes other than those with which

the Act of 1945 was primarily concerned; namely, the fostering of *developing* areas (i.e. areas specially fitted for industrial growth) and the restraint on further development in areas in which industrial congestion is believed to have given rise to serious diseconomies.¹

INDEX OF PRODUCTION²

1938=100

1913	...	65	1946	...	98
1924	...	68	1947	...	104
1929	...	80	1948	...	113
1930	...	74	1949	...	120
1931	...	68	1950	...	128
1932	...	68	1951	...	132
1933	...	74	1952	...	128
1934	...	84	1953	...	136
1935	...	89	1954	...	146
1936	...	98	1955	...	154
1937	...	105	1956	...	153
1938	...	100	1957	...	156

INDEX OF INDUSTRIAL PRODUCTION³

1948=100

					1951	1954	1957
All Industries	...	...	...	...	117	130	138
Mining and Quarrying	...	...	...	...	108	110	109
Chemicals	...	...	...	...	135	168	192
Engineering, Shipbuilding and Electrical							
Goods	...	...	...	...	127	140	156
Vehicles	...	...	...	...	124	155	165
Textiles	...	...	...	...	119	117	114
Clothing	...	...	...	...	111	114	120
Food, Drink and Tobacco	...	...	...	...	105	116	123
Building and Contracting	...	...	...	...	101	115	123
Gas, Electricity and Water	...	...	...	...	124	145	163

¹ See J. Sykes, "The Distribution of Industry", in *National Provincial Bank Review*, May 1956, pp. 16-17. In the summer of 1958 the government announced its intention of exercising more vigorously its powers of restricting new industrial building outside the Development Areas and other places listed as vulnerable to unemployment.

² *London and Cambridge Economic Service*. Covers mining and quarrying, manufacturing, building, gas, electricity and water.

³ Source: Central Statistical Office.

INDUSTRIAL ANALYSIS OF OCCUPIED POPULATION¹ (in thousands)

	1931	1951
Mining and Quarrying	1,040	841
Treatment of non-metalliferous Minerals other than Coal	243	314
Chemicals, etc.	221	435
Metal Manufacture	336	571
Engineering, Shipbuilding and Electrical Goods ...	803	1,766
Vehicles	487	997
Other Metal Goods not elsewhere specified	309	474
Precision Instruments and Jewellery	96	152
Textiles	1,068	986
Clothing	820	717
Leather Goods	78	79
Food, Drink and Tobacco	636	742
Manufactures of Wood	291	326
Paper and Printing	436	515
Building and Contracting	970	1,388
Other Manufacturing Industries	157	262
TOTAL	7,991	10,565

ESTIMATED NUMBERS EMPLOYED IN MINING AND MANUFACTURING² (in thousands)

	June 1948	June 1958
Mining and Quarrying	876	854
Treatment of non-Metalliferous Minerals other than Coal	312	320
Chemicals, etc.	439	527
Metal Manufacture	530	557
Engineering, Shipbuilding and Electrical Goods ...	1,776	2,095
Vehicles	934	1,207
Other Metal Goods not elsewhere specified	501	505
Precision Instruments and Jewellery	127	146
Textiles	922	855
Clothing	597	600
Leather Goods	78	61
Food, Drink and Tobacco	726	905
Manufactures of Wood	283	277
Paper and Printing	463	580
Building and Contracting	1,450	1,498
Other Manufacturing Industries	242	284
TOTAL	10,256	11,271

¹ These figures are based on the reports of the Census of Population, and cover Great Britain only. They exclude persons out of work, and it should be remembered that whereas in 1931 unemployment was very heavy, in 1951 it was very small.

² Source: Ministry of Labour and National Service. The figures cover Great

INDEX OF VOLUME OF EXPORTS¹

1938=100

1913	...	173	1946	...	99
1924	...	132	1947	...	109
1929	...	141	1948	...	137
1930	...	115	1949	...	151
1931	...	88	1950	...	174
1932	...	88	1951	...	174
1933	...	89	1952	...	166
1934	...	95	1953	...	169
1935	...	102	1954	...	177
1936	...	104	1955	...	190
1937	...	113	1956	...	201
1938	...	100	1957	...	205

CLASSIFICATION OF EXPORTS²

(as percentage of total value)

								1935-8 (average)	1955-7 (average)
Coal	...	...	...	...	...	...	...	8	2
Chemicals	...	...	...	...	...	...	...	6	8
Textiles	...	...	...	...	...	...	...	23	10
Machinery	...	...	...	...	...	...	...	13	23
Road Vehicles and Aircraft	...	...	...	...	...	...	...	5	12
Ships and Railway Vehicles	...	...	...	...	...	...	...	2	4
Metals and other Metal Manufactures	...	...	...	...	...	...	...	13	14
Others	...	...	...	...	...	...	...	30	27
TOTAL								100	100

Britain only. Except in Mining and Building, employers and self-employed excluded; these numbered about 200,000 in the manufacturing industries in 1958.

¹ *London and Cambridge Economic Service.*

² Source: Board of Trade.

CHAPTER III

COAL

I

Growth and Decline

No Englishman is likely to underestimate either the importance of coal in the present economy of this country, or the influence of easily worked mines on industrial development in the past. The motive power of all the trades which became paramount during the nineteenth century was derived from coal; the appearance of the great metallurgical industries was associated with the employment of mineral fuel for smelting; and the development of new means of transport by land and sea—a condition of industrial expansion—depended on coal as the source of energy. Coal formed the basis of the economy of the country during the period of her predominance, and the early development of her ample resources enabled her to obtain a long start on other nations. Throughout the nineteenth century, the attracting power of coal was one of the main forces that determined the location of industry, and cheap fuel enabled Great Britain to specialize on manufacture and so to build up a great international trade. In this phase of the country's development coal exports had an influence out of proportion to their magnitude. Most of the British exports were small in volume compared with their value; while imports consisted mainly of bulky materials. Consequently, if there had been no coal exports, a larger proportion of the shipping would have had to leave the British ports in ballast, and freight rates would have been higher than they were. This would have been reflected in the higher prices of raw materials and food-stuffs, and so in manufacturing costs. The development of a coal export trade thus permitted Great Britain to carry industrial specialization a stage further than would otherwise have been possible, and this relationship between coal and the rest of the country's industrial activities well illustrates the organic nature of economic life. Since 1945 the supreme importance of coal has been driven deep into the public consciousness, for the shortage of supplies seriously

handicapped British post-war reconstruction. It is not surprising, therefore, that the coal industry has long been considered to occupy a special position in the economy of the country.

In 1914 the coal industry could look back on a century of almost uninterrupted expansion. At the beginning of the nineteenth century the annual output, it is estimated, was about 10 million tons. In 1860 it had increased to 80 million tons, in 1880 to 147, in 1900 to 225 and in 1913 to 287 million tons.¹ Thus, in the half-century before the First World War, output had more than trebled. The employment afforded by the industry had grown to an even greater extent; for the number of workers had risen from about 200,000 in 1850 to 1,127,000 in 1913. During the pre-war period the number of coal-miners was increasing much faster than the occupied population as a whole. In 1881 only 3·4 per cent of the occupied population was engaged in this industry; by 1911 the proportion had risen to 5·6 per cent.² If we take account only of the male occupied population, we find that in 1913 coal-mining afforded employment to about one-tenth of the whole.

Increased demand from abroad was largely responsible for this high rate of expansion. In the sixties the export trade had been comparatively small and amounted, between 1866 and 1870, to an annual average of just over 10 million tons. By the end of the century, exports were five times as great and accounted for 24 per cent of the output. In 1913 they were 98 million tons, about one-third of the country's production.³ The increase in the relative importance of coal exports in the British foreign trade may be judged from the fact that whereas in the late sixties they were, in value, under 3 per cent of the total exports of British produce, by 1913 they were over 10 per cent.⁴ The great foreign trade in coal was, therefore, a product of the forty years before the First World War, years which witnessed the industrialization of Europe, the introduction of the steel steamship and the expansion in the tonnage of ocean-going shipping.

The rapid growth of the coal industry obscured a certain instability in its position. The expanding demand for coal could be met only by working less and less fertile mines and seams, and the increasing

¹ Statistical data in this section from *Mineral Statistics*, Home Office Reports, 1854-96; and *Mines and Quarries Reports*, 1897-1920; Mines Department, *Annual Reports*.

² *Survey of Industrial Relations*, p. 416.

³ These figures include coal shipped for bunkers of foreign-going vessels.

⁴ H. S. Jevons, *The British Coal Trade*, p. 676.

exhaustion of the easily accessible coal was raising the cost of production in the industry. This result was inevitable. In coal-mining, economies in production and improved methods of marketing and transport may for a period counteract the tendency for costs to increase. But sooner or later a time must come, even under the most enterprising management, when output can be maintained only if demand is unaffected by rising prices, or if those engaged in the industry are willing to accept lower wages and profits. In the case of the British mining industry, the long period of its prosperity had produced a structure which did not make improvements in organization and technique easy to bring about.

The annual average output per head reached its maximum during the period 1884-8, and from then onwards there was a steady decline, accentuated after 1908 by the reduction in the length of the working day as a result of the Coal Mines Regulation Act.¹ Yet we have seen that the expansion of the industry was particularly rapid during this period. The explanation is that the demand for British coal was so urgent, both at home and in the export markets, that it was possible for the industry to pass on the burden of increased costs to customers in the form of higher prices without checking sales. It has been calculated that whereas the output of 1913 represented a gain in volume of 26 per cent over the annual average of 1899-1903, the value of the coal increased by over 47 per cent in the same period.² In other words, production increased by one-quarter in tonnage, but by one-half in value. Yet this does not tell the whole story, for in 1896 the downward movement of the general price level was arrested, and there ensued a rise in general prices which persisted up to 1913. Taking these secular trends into account, observers have perceived a significant change in the fortunes of the coal industry just after the turn of the century. Between 1880-4 and 1900-4 it appears that the price of coal rose relative to general prices, and that this increased value more than compensated for the fall in output per head. Between 1900-4 and 1910-13, however, the rise in coal prices was less than the increase in the general level.³ The implication is that while the real value of the miners' yearly output rose from the middle eighties to the opening years of the present century, during the ten years before 1914 it was falling. This change was associated with a tendency for profits per ton and real wages to decline after 1904, in contrast with the previous movement.⁴ In

¹ Royal Commission on the Coal Industry (1925), *Report*, Vol. I, p. 127.

² *Ibid.*, Vol. III, p. 3. ³ *Ibid.*, Vol. I, pp. 128-9. ⁴ *Ibid.*, Vol. I, p. 218.

other words, up to 1900-4 the increased effort required to produce a ton of coal was paid for by customers; after then, part of the increased effort was made without additional payment. One may conclude therefore, that in 1914 the coal industry was rapidly approaching its zenith, for although it might for a time have been able to pass on its increasing costs in the form of higher prices, the search for alternative sources of supply, either of coal or of substitutes, would meanwhile have been stimulated.

The war of 1914-18 crowded into a few years the changes of decades and strengthened influences adverse to the British industry which might otherwise have long lain dormant. On the production side, the immediate effect of the war was to starve the mines of equipment. Owing to the need for economizing man-power, mining activities were concentrated on the winning of easily accessible seams at the expense of future operations, and even so, output declined from the 1913 level. On the marketing side, the war put an end to the European coal trade, and exports were restricted in order to conserve the limited supplies for domestic needs. Throughout the war and the post-war boom the normal operation of economic forces was disturbed by the existence of Government control. When the war was over the disorganized industry was unable to meet the huge demand from its reopened markets. While domestic prices were fixed by the Government at a low level, the urgent requirements of the Continent raised to unprecedented heights the price of the limited amount licensed for export. The coming of the trade depression brought down export prices and led to the hasty removal of Government control over production and prices, and of the limitation on exports. It now seemed that the industry would be able to enter upon the task of reconstruction in order to meet the needs of a changed world. But a series of fortuitous events occurred which, though they brought immediate advantage to the industry, were of doubtful ultimate value, since they delayed its reorganization. In 1922 there was a sixteen weeks' strike in the United States coal-fields which lifted the British industry from depression. When that influence had been removed, the occupation of the Ruhr by the French, in January 1923, led to a reduction of the German output and so gave a stimulus to the British coal trade, which lasted for over a year. During this period high profits were earned; wages, which were falling in other industries, were raised, and the labour force was considerably expanded. The revelation of the industry's true position came late in 1924, when normal sources of world supply

were restored; but the task of grappling with the difficulty was again delayed through the granting of a Government subsidy to the mine-owners from August 1925 to May 1926. The subsidy led to a temporary revival of the export trade. In May 1926 a national coal stoppage, due to the dispute about hours and wages, began, and this lasted for seven months. It was not until 1927, therefore, more than eight years after the war, that the industry was at last freed from the influence of fortuitous and temporary demands and of subsidies. For more than a decade the normal process of adjusting the industry's organization and resources to changing world conditions had been suspended, and, meanwhile, those conditions had altered with exceptional rapidity.

Before 1914 world coal consumption was increasing at the rate of 4 per cent per annum; but in 1924-6 consumption was lower than in 1913, and even in 1928 it was only 4 per cent and in 1929 9 per cent greater than in the pre-war year.¹ Compared with its pre-war rate of expansion, and with the growth of production in other industries, the development of the coal trade had thus been greatly retarded. The main causes of this stagnation were the economies effected in the use of coal and the introduction of alternative sources of power. Improvements in boiler and furnace technique had led to the conservation of heat and to the extraction of the maximum energy from the fuel burnt. Further economies in the use of coal were obtained by its conversion into electrical energy, and in some countries the generation of electricity by lignite and water-power led to a displacement of coal. The difference between the 1913 output of lignite in Germany and that of 1929 was the equivalent of 19 million tons of coal; and in Italy the additional annual production of hydro-electric power during the same period represented a requirement of 9 million tons of coal.² These changes were accompanied by a revolution in transport caused by the perfection of the internal-combustion engine and by the reduction in the price of oil. In some countries the growth of road transport retarded railway development to the detriment of the coal industry, and oil-burning and motor ships took the place of coal-burning steamships. In 1914 the proportion of the world's mercantile tonnage dependent on oil

¹ League of Nations, Economic and Financial Section, *The Problem of the Coal Industry*, pp. 6-7; and *Statistical Tables Relating to British and Foreign Trade and Industry, 1924-30*, Part II, p. 8.

² League of Nations, *The Problem of the Coal Industry*, p. 7; and *Statistical Tables Relating to British and Foreign Trade and Industry, 1924-30*, Part II, p. 9. Lignite converted into terms of coal at the ratio of 2:9.

was only 3·4 per cent. In 1932 it was about 40 per cent, and in 1939 54 per cent, and the increase in the total tonnage was quite insufficient to balance the loss to the coal trade caused by this change. Meanwhile the navies became almost wholly oil-burning, and oil fuel became extensively used for industrial purposes throughout the world.

At the same time, world capacity in the coal industry had greatly increased. Besides fostering the search for substitutes, the high price of coal between 1914 and 1920 induced countries which had previously relied mainly on imports to extend their own productive capacity. The development of these additional coal-producing resources, accompanied as it was by a very slow growth in demand, resulted in a large surplus of capacity in the industry. This surplus may be defined as the difference between the tonnage which the existing mines could produce without additional fixed capital and the actual production reached at the current level of prices. It was significant, for instance, that world output was hardly affected at all by the sudden removal of two of its greatest producing areas from the market, the Ruhr in 1923 and Great Britain in 1926. During the twenties the British coal industry was the chief sufferer in these common troubles. Although up to 1925 the state of the British industry could be regarded as a symptom of a general European decline, between 1925 and 1929 the annual output of the Continent showed a steady increase and it was much higher (36 per cent) in 1929 than before the First World War.¹ Great Britain did not share in this recovery, and her output in 1929, a relatively good year, was 4 per cent less than the average of 1909–13. The labour force, which reached its maximum in 1924, fell far below its pre-war figure. Between July 1924 and July 1930 the number of insured workers declined from 1,260,000 to 1,070,000, and the amount of unemployment in the period 1927–30 ranged from 14·6 per cent to 26·8 per cent.

The British coal industry was one of the chief sufferers in the world depression which began in the autumn of 1929. Output declined by about one-fifth and employment shrank still further. In the depths of the depression 41 per cent of the workers in the coal industry were unemployed.² Subsequently, with the general revival of trade, there was a partial recovery; but even in the best year of the

¹ League of Nations, *The Problem of the Coal Industry*, pp. 20–1; and *Statistical Tables, etc., 1924–30*, Part II, p. 8.

² This was in July 1932, when the effects of the seasonal slackness in demand were reinforcing those that arose out of the depression. Even in January 1933, when seasonal influences were favourable, the percentage unemployed was 28.

thirties (1937) output was still 7 per cent less than in 1929 and 16 per cent less than in 1913. Abroad, the record of the coal industry was equally unsatisfactory. World consumption was practically the same in 1937 as in 1929, and international trade in coal fell further. It can be said that, while the fall in British output up to 1929 had been accompanied by a rise in the production of other European countries, during the thirties Britain shared only proportionately in the decline in the European output.

The main causes of the depression in the coal industry during the first inter-war decade have already been sketched. These persisted during the thirties, and they demand close consideration. Unfortunately there were during this period no accurate figures to show in detail the changes in consumption in Great Britain; but the available estimates are sufficient for our purpose. It appears that in 1938 the total home consumption was slightly less than in 1913, in spite of the rise in population and in industrial production as a whole. This can be attributed mainly to the economies in coal consumption and to the use of substitute fuels or sources of power. For instance, the consumption of household coal rose very little because of the introduction of more economical grates and to the more extensive use of gas and electricity for heating. The steep increase in the output of gas in the inter-war period did not lead to a corresponding increase in the consumption of coal by the gas industry because of the adoption of improved types of carbonizing apparatus, e.g. the vertical retort.¹ The heavy fall in consumption by the iron and steel industry may be attributed partly to the decline in pig-iron production and partly to fuel economies in the iron and steel industry as a whole. The great expansion in general manufacturing industry and in the power it required was not accompanied by any increased consumption of coal for several reasons, among them the increased use of gas and oil fuel in furnaces, the replacement of steam-driven by electrically driven plant, and a better utilization of coal in factories. The electricity-generating stations were the one class of user which expanded substantially its coal requirements, but even here the rise in the consumption of coal was not in proportion to the rise in the output of current, and it did not compensate for the drop elsewhere for which the greater use of electricity was partly responsible.²

¹ In 1921 12,300 cubic feet of gas were made per ton of coal carbonized; in 1938 the output per ton had increased to 15,000 cubic feet. See P.E.P., *The British Fuel and Power Industries*, pp. 167-8.

² In 1913 the coal consumption per unit generated was, on an average, 3.09 lb.; in 1938 it was 1.30 lb.

It was, however, the losses in export markets which mainly accounted for the condition of the industry. In 1929, the peak year of the later twenties, British coal exports, including bunker coal for foreign-going vessels, were only 84 per cent of the 1913 exports, and by 1937, the best year of the thirties, they were down to 57 per cent. Thus, whereas the home consumption of coal before the outbreak of the last war was running at about the 1913 level, there had been a persistent decline in exports throughout the inter-war period.¹ The causes of this must be examined.

In 1913 the world output of coal was in the neighbourhood of 1,200 million metric tons, of which the United States produced 517 and Europe 605 million metric tons. The British proportion of the European output was nearly one-half, while Germany's was about one-quarter. The United States, Great Britain and Germany were responsible for practically all the export trade, but as American exports went mainly to Canada and Mexico, they had little direct effect on the European trade, except in times of abnormally high prices. The British share of the exports of these three countries amounted to about two-thirds. As might be expected from the bulky nature of the commodity, Britain's chief foreign markets were in countries within easy reach by sea, mainly the great industrial nations of Europe, whose supplies of fuel could not meet their rapidly increasing needs. Of the total British exports of coal, over four-fifths went to Europe and the Mediterranean, a market which comprised two main sections, the French and Mediterranean market, and the North Sea and Baltic. Outside Europe and the Mediterranean, the only large market was South America, which took about 7 million tons annually. The proximity of British coal measures to the sea, together with the special quality of the coal, had favoured the development of these exports; so that even Germany, with an export trade of her own, found it cheaper to obtain coal from England for the districts served by her Baltic ports than to bring it overland from Silesia and Westphalia.

The changed conditions of the world coal trade after the First World War were very unfavourable to the British industry. Even if its competitive strength had been far greater than it actually was, the export trade would certainly have suffered from the culmination of adverse influences already mentioned, viz. the advance of oil and of hydro-electric power, the increased use of lignite, economies in

¹ The decline in output between 1913 and 1937 was 47 million tons; exports were less by 33 million tons and foreign bunkers were less by 9 million tons.

combustion and the development of new coal resources abroad. But as Lord Beveridge said: "In the difficulties common to the coal industry of all countries the greater age of the British industry, involving an earlier and less efficient layout of mines and a greater exhaustion of easy coal, was sufficient to pick it out to be the principal sufferer."¹

The worsening of Britain's relative position in the international coal trade can be explained only in part by the increased self-sufficiency in fuel of the chief customer countries, for Britain's share of total exports also fell. In 1913 she was responsible for 55 per cent of world exports (including bunkers), in 1929 for 47 per cent and in 1937 for 40 per cent. Her losses were distributed over all her chief markets, although there were striking variations during the period in the losses suffered in each of them. For instance, during the twenties the heaviest losses were sustained in the Baltic markets through competition from Germany and Poland. During the thirties some of this loss was recovered, chiefly because of bilateral trade agreements concluded in 1933 and 1934 between the United Kingdom and the Scandinavian countries; for those countries agreed to take a certain proportion of their coal imports from Great Britain. On the other hand, the British position in certain North Sea and Mediterranean markets (especially France, Belgium, Germany and Italy) worsened. This was in part due to the adoption by those countries of quantitative restrictions on imports which often discriminated against British coal; but it can also be attributed to the increased competition of Polish coal, especially in the Mediterranean. This competition was the direct result of the efforts of the Poles to find compensation for their losses in Scandinavia.² Policy which was aimed in the importing countries at protecting domestic producers and in the exporting countries at stimulating exports was in some measure responsible for these losses; but a widening disparity in costs between Britain and certain foreign countries must bear part of the blame. Before the First World War British output per man-shift compared favourably with that of the Ruhr and indeed with that of most of the major coal-producing countries other than the United States. The reorganization of the German and Polish coal industries after 1925, however, and the progress achieved in the smaller producing countries (e.g. Holland) led to a marked rise in productivity abroad. In Britain, on the other hand, the in-

¹ W. H. Beveridge, *Unemployment*, p. 354.

² Cf. J. H. Jones, *The Coal-mining Industry*, especially Chaps. II and X.

crease in output per man-shift was small, as the following figures show:¹

<i>Country</i>	<i>Basic Year</i>	<i>O.M.S. in Basic Year (cwt.)</i>	<i>O.M.S. in 1936 (cwt.)</i>	<i>Percentage Increase</i>
Poland ...	1927	23.44	36.20	54
Holland ...	1925	16.48	35.94	118
The Ruhr ...	1925	18.62	33.66	81
Great Britain ...	1927	20.62	23.54	14

The causes of these disparate movements will be considered later. Their importance for the present argument is that, through them, British coal became relatively expensive.

It has been alleged that the coal exports of Poland and Germany were stimulated by subsidies or by the practice of charging discriminating prices, and this cannot be denied. Preferential railway rates, for instance, were granted to overcome the disadvantage of the long haul from the Polish coal-fields to Danzig and Gdynia, while the strongly cartelized German industry sold coal abroad at much lower prices than at home. Yet British coal exports also received an artificial stimulus in 1925 from the subsidy of £23 million paid to the industry, and during the thirties they benefited from discriminating pricing and from special favours accorded to British coal by several countries that signed trading agreements with the United Kingdom.

During the discussions about the industry's foreign trade in the inter-war period the weakness of Great Britain in international competition was sometimes attributed to the lower wages of Continental miners, for in this industry wages form a high proportion of the total cost of production. Such an explanation, however, begs several questions. Differences in national wage levels are ultimately determined by differences in the marginal productivity of labour, and there is no reason for supposing that wages in a particular industry are too high or too low unless they are greater or less than those earned by workers of similar skill and efficiency in other trades in the same country. The argument for wage adjustments in the mining industry really turned, therefore, on the question whether

¹ Ministry of Fuel and Power, *Report of Technical Advisory Committee on Coal Mining* (1945), p. 29. This Committee is commonly known as the Reid Committee.

British and Continental miners' wages were higher, or lower, than those paid to similar classes of workers in their respective countries. To this there was a definite answer. Although miners' wages were lower in Germany than in this country, they were higher in Germany than in England relative to wages paid to other classes of workers. As a commentator at the time wrote: "Although the German miner is paid a lower wage than the British miner, he occupies a higher rung on the German wage ladder than the British miner occupies on the British wage ladder."¹ Thus the existence of different wage levels for a particular industry in competing countries is by no means an indication that the proper policy to be pursued in freeing one of them from depression lies in deliberate wage adjustments in that industry. This must depend not merely on the circumstances of the competing industries, but on the relation between wages and productivity throughout the economies of the countries concerned. Further, in the particular case of British mining, the depression could not be attributed to any increase in British mining wages relative to those of the Continent, for over much of the inter-war period the gap between them narrowed. What happened was that the Continental industries became relatively more efficient.

II

Production After 1945

The war of 1939-45 brought with it an entirely new situation in the mining industry. After the fall of France the export trade virtually came to an end. Miners in the exporting areas left the industry, and pits were closed. Production fell, but as the exporting areas were now obliged to sell all their output on the home market, this did not lead to a shortage until the organization of the war economy was completed. By 1942, however, the coal problem had become one of deficiency instead of superabundance. Efforts to overcome the shortage by redirecting former miners into the pits, by fuel economy campaigns, and by the development of open-cast mining, were only partially successful, and the difficulties were accentuated by the fall in productivity. By 1945 output per man-shift worked had declined to 1 ton, compared with 1.14 tons in 1938. The problem became even

¹ J. H. Jones, "The Present Position of the British Coal Trade" in the *Journal of the Royal Statistical Society*, Part I, 1930, p. 7.

more serious after the end of the war, for the recovery in production was very slow, and the breakdown of fuel supplies during the severe winter of 1947 provided a dramatic example of the disastrous effects of a prolonged coal shortage on the British economy as a whole. After 1947 productivity improved and by 1950 output per man-shift exceeded that of 1938; but subsequently there was only a slight increase and between 1954 and 1957 none at all. In the latter year output per man-shift was only about 6 per cent higher than in 1938. This modest rise in productivity was quite insufficient to offset the effects on output of the loss of man-power. At the end of the war there were 9 per cent fewer miners than in 1938 and, despite some increase during the next few years, by 1957 numbers had declined still further. The result was that in the post-war period the output of deep-mined coal never regained its pre-war level, and even if the output of 11-12 million tons a year from open-cast workings is included, the total was substantially less. The recovery that occurred after 1947 had spent itself by 1951, for after that year output remained stationary.

Meanwhile the home demand had increased because of the expansion of industry, while the foreign demand, apart from coal for ships' bunkers, was probably at least as great as before the war. The Ridley Committee estimated in 1951 that, at the level of prices then ruling, the annual output was 15 or 20 million tons below demand, and it may well be that this was an underestimate.¹ In these circumstances, a balance between supply and demand was achieved only by restricting deliveries to industrial, commercial and household customers, by limiting exports and by bringing supplies from overseas. Here we come to the most striking effect of the failure of the industry to restore its output, the transformation of its position in international trade. Whereas in 1938 exports amounted to 36 million tons, throughout the period 1951-6 they never exceeded 14 million tons and in 1957 they were less than 7 million tons. The amount of coal supplied for bunkering foreign ships also fell from 10½ million tons in 1938 to 4 million tons in 1950 and 1½ million tons in 1956. There can be little doubt that, although the decline in foreign bunkers can be attributed to the continuance of the pre-war trend for oil to replace coal for ship propulsion, the exports themselves were curtailed solely by lack of supply.

At the same time the shortage of coal for home use required im-

¹ Committee on National Policy for the Use of Fuel and Power Resources, *Report*, p. 3.

ports on an increasing scale, chiefly from the United States. Between 1947 and 1956 they aggregated nearly 23 million tons. In 1955 they were in tonnage almost as large as the exports and their value was much higher. Thus Great Britain which 45 years ago sold about a third of her output abroad is ceasing to rank as a coal-exporting country. Before the First World War the value of coal exports came to about one-tenth of the total value of British exports; in the middle fifties coal imports cost considerably more than the revenue earned from coal exports. Yet the industry still remains, and for a generation to come is likely to remain, the source of by far the greater part of the power and heat required in Great Britain. At present oil furnishes only about 15 per cent of these requirements and hydro-electric power only 0.5 per cent.¹ Even by 1965, when atomic power is likely to be used on a considerable scale for the generation of electricity and when the total need for heat and power will presumably be far greater than at present, it is estimated that coal will still supply four-fifths of the needs of the British economy.² As a source of raw materials for such industries as plastics and man-made fibres, the importance of coal derivatives is likely to increase substantially.

These forecasts, however, are all based on estimates that must be highly speculative, and history should warn us that trends in this industry are liable to sudden and dramatic changes. Before 1914 when demand, especially foreign demand, was expanding rapidly, it was argued that it might be expedient to restrict sales overseas in order to conserve the resources of easily-won coal. In the inter-war years the fall in foreign demand brought chronic depression to the industry and policy was directed towards stimulating exports by subsidies, differential prices, and bilateral bargains between the British and other governments. From the end of the Second World War until 1957 the chief aim was to overcome the shortage of supply even if this meant resorting to methods that had little regard for costs, and profitable foreign sales were limited so that home consumers might be served. In 1958 the industry entered upon another phase. With the end of the industrial boom the demand for coal fell and, for a time at any rate, the problem of disposal reappeared. Opportunities in foreign markets which could not be seized during the time of shortage were much reduced, for Continental demand, lessened by the depression, was still being satisfied in part by American coal bought

¹ National Coal Board (N.C.B.), *Report and Accounts for 1956*, Vol. I, p. 35.

² N.C.B., *Investing in Coal*, p. 13.

on long contracts. Attention was now called to the unbalanced character of British production, for while large coal was still scarce, stocks of small coal began to accumulate. The question of the relative costs and prices of the different types of coal became a leading pre-occupation of the National Coal Board, especially as these circumstances emphasized the danger of the competition from oil.¹ The immediate response of the Board to the depression was to abolish the voluntary Saturday shift, to cease to recruit labour and to close down many uneconomic mines. It may well be that the Board's production and investment plans will require revision in the light of these new conditions.² This experience has brought out the necessity for flexibility in mining policy, a quality which is likely to become even more essential than in the past because of the incalculable effect of technical developments on the chief customer-industries and of the increasing competition from other sources of power.

III

The Major Coalfields

The coal measures of Great Britain, unlike those of the leading European producing countries and of America, are geographically scattered, a characteristic which has had an effect on the organization of the industry in the past. The chief coal-fields at present are:

(1) *The Yorkshire, Nottinghamshire and North Derbyshire field*, which accounts for the bulk of the production of the North-eastern and East Midland Divisions of the National Coal Board;

(2) *The Durham and Northumberland field*, which, with the addition of the small Cumberland field, makes up the area covered by the Durham and the Northern Divisions of the National Coal Board; and

(3) *The South Wales and Monmouth field*, which together with the small fields of the Forest of Dean, Somerset and Bristol, comprises the territory of the South-western Division.

These three fields in 1946 were responsible for about two-thirds of the total output of deep-mined coal. Of secondary importance were the fields of Lancashire and Cheshire, with about 6 per cent of the

¹ Between 1951 and 1957, while coal prices rose by about 60 per cent, fuel oil prices rose by only 20 per cent.

² See pp. 87-9 *infra*.

total output, and Lanarkshire with 5 per cent. The remainder was produced by numerous small fields situated in North and South Staffordshire, Warwickshire, South Derbyshire, Leicestershire, North Wales, Shropshire, the Forest of Dean, Kent, Fife, Ayrshire, Cumberland and Lothian—in that order of importance.

Since coal-mining results in the increasing exhaustion of an irreplaceable material, it is to be expected that the history of the industry will show many examples of changes in the relative importance of the different fields. There has, indeed, been a continuous process of closing old mines and opening new ones, and this has brought gains to some areas and losses to others. Before the First World War, when the coal industry as a whole was expanding, the three major fields were increasing their output at a rate greater than that of the country as a whole. For two of the fields this rapid expansion was associated with the growing export trade. The chief coal ports were those of the North-east Coast and of South Wales. The former exported the produce of Northumberland and Durham and had a slight predominance in the coal trade with northern and eastern Europe. (It had, also, a large coasting trade with the south of England.) The South Wales coal was exported to France, the Mediterranean and South America as well as to the North Sea ports of Europe.¹ About half of the output of these two coalfields was exported, and together they were responsible for nearly three-quarters of the British foreign trade in coal. The mines of Northumberland and Durham, however, had been worked for centuries, and many of the best seams were becoming exhausted. While, therefore, it was possible to increase output during a time of growing demand, the rate of expansion could not rival that of South Wales, where there was a great store of valuable steam coal which had scarcely been touched before 1860 and was in great demand for shipping. Nor was it to be expected that Durham's rate of increase should equal that of the Yorkshire and Nottinghamshire fields. Although the mines of this area produced only a small proportion of their coal for foreign markets, yet they had the advantage of a favourable situation for serving the industrial Midlands and the south, and they possessed vast stores of good coal. Consequently Durham and Northumberland, the most important producers in 1870, had been surpassed by the Yorkshire and Nottinghamshire field in 1900, and by South Wales in 1913. Meanwhile certain other fields, previously of great importance, had made only a moderate

¹ H. S. Jevons, *op. cit.*, Chaps. IV, V, XXIV.

advance, and so had declined relatively. Mining areas such as Lancashire, the West Midlands and Scotland were suffering from the early exploitation of their resources, and were finding it difficult to increase their annual output.

During the inter-war period the districts with a high proportion of their mines on the margin of profitable enterprise were hard hit. As the chief losses in trade were suffered in the export markets, the output of both South Wales and of Northumberland and Durham was reduced. The former suffered exceptionally severe losses. This was partly because of the heavy decline in the demand for one of the classes of coal in which it specialized, namely smokeless steam coal. Further, during the later twenties, the Northumberland and Durham field improved its position relative to South Wales "by imposing more onerous conditions of employment than those prevailing in other parts of the country."¹ In the next decade, the same area reaped most of the benefit of the trade agreements with Scandinavian countries, while South Wales, in her Mediterranean markets, suffered from increased competition from Polish coal which the agreements diverted from their former markets in northern Europe. It has indeed been well said that the net effect of the trade agreements with the Scandinavian countries was not to benefit the British industry at the expense of the Polish industry, but rather to benefit the North-east Coast producers at the expense of the South Wales producers.² Scotland, another exporting area, also lost much of its foreign trade and declined in relative importance. The only large field which showed an increase was Yorkshire and Nottinghamshire, and this improvement was accomplished by the exploitation of the deep coal in the south-eastern part of the field. Yorkshire's markets were not so much disturbed as were those of South Wales and Durham by the changes of the inter-war period. As it was not primarily an exporting area, it did not suffer so severely from the depression in foreign trade, and its customers who comprised mainly the populations of the Midlands and the south were prosperous, in contrast with those of the North-east Coast, Scotland and South Wales.

During the Second World War it was the exporting areas which again suffered contraction, and the inland districts were much less affected by the call-up and the closing of mines. As a result the Yorkshire, Nottinghamshire and North Derbyshire field in 1946 was

¹ J. H. Jones, *loc. cit.*, p. 25.

² J. H. Jones, *The Coal-mining Industry*, p. 177.

responsible for 36 per cent of the total British output of deep-mined coal, whereas the share of South Wales and Monmouth, which in 1913 had been one-fifth of the total, had sunk to only 12 per cent. During the last ten years these trends have persisted with the result that by 1956 the share of the Yorkshire, Nottinghamshire and North Derbyshire field had risen to about 39 per cent. Meanwhile, the Durham and Northumberland field barely maintained its importance, the share of the South Wales and Monmouth field declined further, and the Scottish fields taken as a whole suffered an absolute decrease in output.

The locational changes of the last decade have been analysed in some detail by the National Coal Board. For this purpose it has classified the mines into four groups: A, new collieries under construction and collieries undergoing major reconstruction; B, collieries scheduled for reconstruction; C, collieries that are to continue without major reconstruction; and D, collieries that have been closed or are due to close because of the exhaustion of their coal.¹ The impact of projects under these several heads on the prospective output of the different fields varies considerably. During the period from 1950 to 1956, however, the improved output arising from development and reconstruction work under A and B was still to come, whereas the running-down of output from collieries in group D was proceeding rapidly. The recent changes in the relative importance of the several fields are, therefore, closely related to the uneven geographical distribution of collieries in that group. This explains, in large part, the absolute decrease in Scotland and accounts for the declining shares of South Wales and Monmouth, the West Midlands and Durham. Other forces, however, have also been at work. For example, the advance in the Yorkshire field (North-eastern Division), though considerable, has been less rapid than might have been expected from the distribution of its collieries among the four groups. In that field the shortage of manpower and labour unrest have had a depressing effect on output. On the other hand, the rise in the Nottinghamshire and Derbyshire field (East Midland Division) can be partly attributed to progress in the mechanization of collieries in group C and to good labour relations.

The execution of the plans for development and reconstruction will, of course, affect the geographical pattern of coal production during the next few years, and in some fields where output has recently been stationary or declining, a recovery may be expected.

¹ N.C.B., *Reports and Accounts for 1956*, Vol. I, pp. 10-11.

For instance, the Scottish output, which has fallen during the last decade, should rise by 25 per cent between 1956 and 1965, compared with an increase in the entire industry of only 10 per cent. On the whole, however, recent trends in the importance of the different fields are likely to persist, the Yorkshire, Derbyshire and Nottinghamshire field advancing, the Durham and Northumberland, the North-western and the West Midland fields relatively declining, and the South Wales and Monmouth field almost stationary. These are forecasts. The results may be very different.

IV

The Organization of Coal-mining

The Royal Commission on the Coal Industry (1925) laid much emphasis on the extreme diversity to be found in the industry's structure. In some respects this diversity has persisted down to the present time; in other respects the last thirty years have witnessed a succession of striking changes which make the generalization no longer true.

So far as the product of the industry is concerned, it does not differ from that of any other large trade in being heterogeneous. Coal varies from district to district and from mine to mine in its physical and chemical properties. Upon these depend its commercial value and the uses to which it can be put. There are variations in calorific value, in moisture content, and in the proportions of volatile matter and of carbon. At one end of the scale comes bituminous or soft coal, which has a low proportion of carbon, but a high proportion of volatile matter. At the other end is anthracite, or hard coal, with over 90 per cent of carbon. Between these extremes come gas coal, steam coal and smokeless steam coal and many others. As is suggested by these terms, each type has special purposes for which it is most suitable; but fluctuations in the relative prices of the different varieties have led to a considerable amount of interchange.

Even the coal produced by a particular colliery is likely to be of different types and sizes which sell at widely varying prices in a large number of markets. The product has to be graded to meet the needs of different kinds of consumers, and a large proportion of the small coal is washed or cleaned in elaborate plants so as to remove impuri-

ties. This practice became increasingly common in the inter-war period, and the proportion of the whole output treated in such plants rose from 20 per cent in 1927 to 45 per cent in 1938. In 1949 it reached 50 per cent and in 1956 60 per cent.¹ The practice of blending different types of coal has also grown, for this enables special types of fuel suitable for specific purposes to be provided. Grading, however, cannot be regarded solely as a device for meeting the special needs of consumers. In the past, new grades differing little in physical composition from existing ones, were sometimes introduced with the object of enabling the producer to charge discriminating prices, and were thus a means for introducing imperfections into the market. It can easily be believed that the 1,200 or more market specifications of coal which once existed in the Lancashire industry did not all owe their existence to the varieties of product required by consumers. As the Reid Committee declared: "An excessive multiplication of qualities and sizes . . . had unfortunate effects upon the efficiency of mining and surface operations."²

Most of the coal consumed in this country is burned in a raw state. An alternative method of using it is to decompose it in closed retorts. By this process gases and liquids are given off, and these form the basis of large branches of the oil, gas and chemical trades. The residuary solids may, if a suitable coal of "caking" quality is employed, provide a coke which is more suitable than coal for some manufacturing purposes, notably for smelting iron ore in blast furnaces. These processes of coal utilization have become increasingly important with the development of various synthetic products such as plastics. Even if coal as a fuel were to be superseded, it would probably long remain an important source of industrial raw materials.

The diversity extends to the technical unit (the mine) and, until the nationalization of the industry in 1947, to the unit of control (the firm). In 1944 there were 1,630 mines belonging to about 740 undertakings. The latter ranged from large companies controlling several mines and employing thousands of men (e.g. Powell-Dyffryn Associated Collieries with 93 pits and 38,000 men) to small mines operated by a dozen miners. Although the small mines were very numerous, the bulk of the output was obtained from large mines.

¹ N.C.B., *Report and Accounts for 1949*, p. 64; and *Report and Accounts for 1956*, Vol. I, p. 15. In addition to the output that is mechanically cleaned, about 19 per cent is cleaned by hand. It should be observed that underground mechanization has increased the amount of dirt brought to the surface.

² *Report of Technical Advisory Committee on Coal Mining*, p. 38.

Eighty-three per cent of the output came from 538 mines employing 500 or more workers, and well over half from mines with a thousand and over. Twenty years earlier the number of both mines and undertakings was much larger, 2,480 and 1,400 respectively. The shrinkage in the number of producing units was clearly far greater than the fall in output over that period. This was brought about by the closing of many uneconomical mines, especially small ones, and by amalgamations among the companies controlling the industry. There was thus a considerable change in the structure of the industry, as well as in its location, during the period of its contraction.

The size of the mines depends largely on the nature of the coal deposits and their accessibility. For instance, small mines are still numerous in South Wales, South Staffordshire and Lanarkshire, where much of the coal is near the surface. On the other hand the largest units are found in the more newly developed deep-mining district of South Yorkshire. The nationalization of the industry, while it removed diversity of ownership, could not destroy the variety in the size of the mines in so far as this depended upon physical characteristics. But other factors have contributed to that variety. Thus, until 1938, the coal was the property of the surface landlords from whom the mining companies leased their rights, and the nature of the pits was governed in some degree by the extent of the landowner's property, the terms of the lease and the capital of the mining concerns. These factors tended to increase the diversity in the size of the mines and are generally considered to have impeded the evolution of a more economical structure. Certainly, even after the changes of the previous twenty years, the British industry in 1946 with its numerous independent undertakings and multitude of mines presented a striking contrast to the mining industry of Germany where, as long ago as 1928, 70 companies and 175 collieries produced 152 million tons of coal. In Westphalia at that time fewer than twenty companies controlled nine-tenths of the output.¹

Along with this variation in size there was in Great Britain great diversity in mining methods and in production costs from mine to mine and from district to district. The overall output per man-shift in 1946 ranged from 1.67 tons in Leicestershire and 1.47 tons in Nottinghamshire to .76 in South Wales and Monmouth, .69 in Cumberland and .53 in Bristol. These figures, however, should not be taken as measures of efficiency, since the districts produced

¹ *Ibid.*, p. 16.

different types of coal under different physical conditions. For instance, in 1938 costs ranged between 14s. 4½d. a ton in Nottinghamshire and North Derbyshire, to 18s. 3d. a ton in South Wales, a difference which matched that in output per man-shift. Yet, the high costs and low man-shift output in South Wales were not the result of inefficiency, but rather of difficult working conditions. Since Welsh coal is of very good quality it can command a higher price than that of most areas, and this justified the higher costs of operating Welsh mines. Again, in Lancashire, mining costs were high and output per man-shift low; but delivery charges were small since that industry had a great market close at hand. In Nottinghamshire, where the cost of getting the coal was low, the cost of distributing it was high; for much of the output had to be sent by rail to distant markets. The Samuel Commission in 1925 was confronted by these intricacies when it attempted to correlate size and efficiency. It found that output per man-shift rose with the increase in the size of the undertaking and that costs fell with absolute regularity. In spite of this, however, the small concerns had been able to survive because their proceeds per ton were higher than those of large concerns; this was generally because of special advantages, either in the quality of their coal or their proximity to a market. When finally an attempt was made by the Commission to balance costs against proceeds for different classes of mine, the result was inconclusive, for highly profitable undertakings were found in every size-group.¹ The authors of the Reid Report in 1945, critical as they were of the organization and technique of the coal industry, were likewise unable "to suggest what size of unit would provide the best foundation on which to reconstruct the industry." They added: "Indeed, there would necessarily be variations from the optimum size according to local conditions."²

It does not follow, of course, that the absence of a single optimum in the mining industry means that all or the majority of mines are of the right size. There were, according to the Reid Committee, mines that could with advantage be closed and their reserves worked from adjoining collieries, and undertakings which had a lease of coal that could be worked more efficiently by other undertakings. These and other examples were quoted to show that the system of ownership or control had produced a faulty structure. The Committee looked to the unification of control in areas of "manageable

¹ *Report of Royal Commission on the Coal Industry (1925)*, Vol. I, pp. 54 *et seq.*, 259 *et seq.*

² *Report of Technical Advisory Committee on Coal Mining*, p. 138.

size" to bring about the required reorganization, and in this their views accorded with those expressed by several inter-war investigators.¹ Unification may overcome the disadvantages that attend an industry composed of numerous independent undertakings working under conditions of imperfect competition, especially when these conditions are being intensified by legal and institutional factors which hinder the pursuit of operational economies. But unification cannot be expected to overcome disadvantages that arise from physical factors. A large undertaking can achieve economies in the provision of power, supplies, repair shops and transport; it can afford skilled management and adopt improved methods of mining technique more readily than the small units. But unification must still leave mines operating at very different levels of cost in so far as these depend upon differences of age and accessibility of coal resources. This is relevant to a consideration of the results achieved by nationalization, a subject to which we shall return.

The Reid Committee addressed itself to the causes of the relatively slight advance in output per man-shift in Great Britain compared with that in other countries. Mechanization is one of the chief means by which in all countries productivity has been raised during the last forty years. This mechanization has taken various forms and has been applied to the cutting of the coal, its loading on conveyors and its transport to the shaft. In 1913 only 8 per cent of British coal was cut by machinery, but there was a steady advance after then. In 1924 the proportion was 19 per cent, in 1933 42 per cent, in 1939 61 per cent and in 1944 72 per cent. In 1944, moreover, 69 per cent of the coal was conveyed from the face by mechanical means compared with 54 per cent in 1938.² Mechanized mining proceeded at varying rates in the different coal-fields according to the conditions of mining in them, and even in the middle forties there were striking contrasts between the several districts. In Northumberland, for instance, 94 per cent of the coal was cut, and 50 per cent of it conveyed, by machinery, whereas in South Wales the proportions were 32 and 55 per cent respectively. Abroad mechanization occurred earlier. Thus, by 1928, 85 per cent of the coal mined in the Ruhr was cut by machinery. As it was after this time that the wide disparity between output per man-shift in this country and abroad became

¹ *Ibid.*, pp. 137-8.

² Mines Department, *Annual Reports*; Ministry of Fuel and Power, *Annual Statistical Digests*. In 1949, 78 per cent was cut by machine and 82 per cent conveyed mechanically.

evident, the cause cannot lie in contrasts in mechanization, for during the thirties, when the difference in productivity was becoming wider, the difference in the degree of mechanization was declining. The Reid Committee, indeed, attributed the British inferiority mainly to other factors.¹ Its conclusion was that in countries where mining conditions most closely resembled the British, as in the Ruhr and Holland, the advance in productivity had been due to the concentration of working places, which not only meant the use of the men at the face to the best advantage, but also brought economies in haulage. Further, the layout of the British mines, with their undulating and circuitous roadways, contrasted unfavourably with that of the Continental mines, where straight roads were driven through the strata. The latter were able to use modern locomotive haulage instead of the old-fashioned systems employed in Britain. To this was ascribed an important cause of the lower output per man-shift of the British mines compared with that of the mines of the Ruhr and Holland. For instance, whereas a haulage worker could handle 20 to 25 tons a day in Holland, in Great Britain his capacity was 5 tons.

After nationalization important changes occurred in the number and size of the producing units and in technique. In January 1956 there were 850 National Coal Board collieries compared with 980 in January 1948,² and the tendency towards the concentration of output had clearly proceeded further. Yet the diversity in size, productivity and costs of these mines and the contrasts among the various fields in all these respects persisted. Output per man-shift (overall) varied from 1.84 tons in the East Midland Division to .94 in the South-western Division, with an average for Great Britain of 1.23. Average costs per ton in 1956 ranged from 56s. 1d. in the East Midland Division to 91s. 7d. in the South-western Division, and the financial results, from a loss of 7s. 3d. a ton in Scotland to a profit of 9s. 6d. a ton in the East Midlands. If one looks at the results of the different Areas the range is, of course, much wider.³

In technique there were advances almost everywhere. By the late

¹ *Report of Technical Advisory Committee on Coal Mining*, pp. 24, 37; cf. A. Beacham, "Efficiency and Organization of the British Coal Industry" in the *Economic Journal*, June-September, 1945.

² There were 540 small collieries operated under licence from the N.C.B. The number of these licensed collieries had increased in recent years, but their aggregate output in 1956 was only 2.6 million tons, 1½ per cent of the deep-mined output.

³ For a discussion of the administrative Divisions and Areas, see p. 82 *infra*.

forties, as already shown, the bulk of the coal was being cut and conveyed mechanically and little further progress was possible in those processes. But at that time nearly all the coal was still loaded on the conveyors by hand. Since then mechanical loaders have been extensively adopted. Whereas in 1950 under 4 per cent of the output was power-loaded, in 1957 the proportion had risen to nearly 20 per cent. Efforts were also made to improve the layout of the mines and better methods of tunnelling were brought into use. Continuous technical advances such as these are needed merely to offset the effect on productivity of working to greater depths and of resort to inferior seams as the best measures become exhausted. So far, indeed, this is all that they have achieved. Advances in productivity sufficient to reduce costs and to render the industry profitable are still only in prospect.

V

Marketing

As with all bulky commodities the cost of distributing coal is very high. About 78 per cent of the coal sold to inland consumers leaves the collieries by rail and about 17 per cent by road. Some of the rail-borne coal goes to the ports adjacent to the fields whence it is sent by sea to other parts of the country. About 15 per cent of the total inland supply is handled by coastwise shipping.¹ The wide margins between pithead prices and those paid by consumers provoked the criticism of many investigators into the coal industry, from the Coal Commissions of 1919 and 1925 onwards. The ratio of distribution costs to the total tended to rise during the inter-war period, as in many other trades. This could be attributed to the increase in labour costs in the transport and distributive industries and to the tendency towards deglomeration on the part of the urban population as well as to the relatively low pithead prices of coal.²

Before nationalization the agencies for the distribution of coal in the home market fell into three main groups—the wholesaler or factor, the merchant and the retailer. The wholesaler purchased coal in quantity from the collieries and sold it to other distributors or to large consumers. For handling the sea-borne coal, which represented

¹ *Report of the Committee of Inquiry into Coal Distribution Costs in Great Britain*, p. 2.

² In January 1958 about 37 per cent of the price paid for domestic coal was accounted for by transport and distributive charges, on an average. *Ibid.*, p. 6.

about half the consumption of London and a considerable proportion of the consumption of other southern towns, the wholesaler usually provided himself with discharging appliances at the ports, and he looked after the transport of coal from ships to barges and railway trucks for the purpose of storage, or for transit to his customers. In the case of rail-borne coal he usually took possession of it at railway depots. The factor acted as an intermediary between the collieries and the smaller wholesaler. He provided many of the wagons required to transport the coal and he financed his customers by giving them long credits. The coal merchant bought from the wholesaler and stored his coal in depots from which it was sent by road to householders or to small industrial concerns. The retailer was a small man who bought at the merchant's wharf and disposed of the coal in bags to the poorer domestic users.

Individual colliery companies usually employed salesmen or "fitters" who sold the coal to factors and wholesalers. Some collieries dealt through exclusive selling agencies and others had large selling organizations and depots of their own. Exports were dealt with by firms that specialized in the business and had close connections with particular foreign markets.

The structure of distribution was modified as a result of nationalization but not fundamentally changed. The private merchanting organizations were not disturbed, but the sales organization and depots of the collieries passed into the hands of the National Coal Board, and for some years the various Divisions and Areas handled the sale of the coal which they produced. Then, in 1954, the Board set up nine Regional Sales Offices, each responsible for sales within its own region irrespective of the source of supply. Industrial consumers are supplied either through wholesalers and merchants or direct from the Sales Offices; in recent years about half this coal has been sold direct. Domestic consumers normally buy from the merchants with whom they are registered, but in some regions a considerable trade is done with householders from the Board's own retail depots.¹

Another change introduced by nationalization into coal distribution was in connection with the ownership of the coal wagons. Formerly a large proportion of these belonged either to colliery companies or to distributors, a form of ownership that was adversely criticized on the ground that, by limiting the number of journeys that a wagon might undertake during a period, it contributed to the high cost of coal transport. When the National Coal Board took over the

¹ N.C.B., *Report and Accounts for 1956*, Vol. I, p. 43.

mines the mining companies still owned 170,000 main-line wagons and 60,000 "internal user" wagons for use within the collieries themselves, although from 1939 the main-line wagons had been under requisition by the Ministry of War Transport.¹ From January 1st, 1948, when the railways were nationalized, the main-line wagons were vested in the British Transport Commission, and so only the "internal user" wagons remained the property of the coal industry. The protracted debate on the ownership of wagons was at last brought to a conclusion.

Apart from these modifications in the methods of distribution, the various markets themselves were profoundly affected after the war by alterations in the country's industrial structure.² The export trade, as already shown, was greatly reduced, while the home trade as a whole expanded. Among the chief classes of domestic customer, the railways, coastal shipping and the collieries themselves declined in importance, and household consumption did not increase in spite of the rise in population. On the other hand, consumption by electricity generating stations trebled, compared with that of 1938. This growth is in continuance of a trend prevalent for the last forty years, but it has been strengthened since the war both by coal "rationing" and by the relatively low prices charged for electricity. The rise in consumption by coke-ovens reflects the high rate of activity in the iron and steel industry.

VI

Cartels

Until the later twenties, the organization of the coal industry remained typical of the period in which it rose to prominence, and it was then one of the most individualistic and competitive of British industries. In it the family business was still very common and, as we have seen, there was an absence of uniformity in productive methods and in organization. The market in which the producers operated was an unstable one. Even during the era of rapid development, violent alternations of short periods of prosperity and adversity were suffered, and the level of prices, profits and wages was never for long free from change. This instability was due to three sets of influences. First, as coal is a raw material employed

¹ N.C.B., *Reports and Accounts for 1947*, pp. 74, 141.

² See Table on p. 91. *infra*.

largely by the heavy constructional industries and by shipping, the unstable character of these trades communicates itself readily to mining. Secondly, the part of the trade that is engaged in supplying household coal is seasonal. This characteristic was to some extent mitigated before 1914 by the large export trade, part of which (e.g. the trade with Russia and the Baltic), was most active in summer. The decline in this export trade weakened an influence which tended to steady the seasonal demand. But reliance on exports led to instability of a third kind. The danger of unforeseen changes in demand usually accompanies trade with distant consumers.

These fluctuations in demand were serious, because owners could neither produce for stock for any length of time, nor adjust their output easily to changes in demand. A mine works with a heavy burden of overhead charges which continue even if output is reduced. Maintenance costs and winding costs, for example, remain much the same whether a pit is being worked at full capacity or not. So the reduction of supply to meet a diminished demand is not likely to take place quickly. On the other hand, the time required to restart abandoned workings and to sink new shafts delays the response of output to an increase in demand. In a competitive régime a high degree of price instability is a natural concomitant of these conditions, especially as, in the short period, demand appears to be highly inelastic. In times of depression, very heavy price reductions have to be made in order that the normal output can be sold.

Mine-owners tried to protect themselves against the results of this price instability by various devices. For many years wages in the leading coalfields were settled on a "sliding-scale" basis, rising and falling with the price of coal. The inter-war wage settlements, according to which proceeds were allocated to wages and profits in agreed proportions, represented, with some modifications, the application of the same principle. In marketing, also, owners tried to guard against price changes and to ensure a steady flow of orders essential to the economical management of a mine, by contracting ahead for their output. Much of every colliery's coal was sold on forward contracts either to wholesale merchants, who took the risk of price fluctuations, or to large consumers. This practice enabled a manager to adjust his production in the expectation of finding a regular market for his coal at prices known ahead.

The fluctuations in coal prices provided a strong inducement towards the establishment of various kinds of price control, and loose horizontal associations were formed in this and other countries from

time to time. These usually took the form of pools or cartels. They left the producers with their individual identities and profits, and their main object was to adjust output to changes in demand so as to ensure remunerative prices. The best-known example of cartels of this character is the Rhenish-Westphalian Coal Syndicate, which from 1893 controlled the greater part of the coal industry of the Ruhr. This organization allocated to each producer a proportion of an agreed output, undertook to dispose of it and fixed selling-prices for different markets. In England the Newcastle Coal Vend, organized on somewhat similar principles, controlled the sales of coal sent by sea from the North-east Coast to London for many years. But it broke down in 1844 when Newcastle coal began to meet with the competition of other coal transported by rail to the London market. From this time onwards, the industry in Great Britain was highly competitive, and few instances of large combinations were recorded. For this, the scattered character of the coal resources, the large number of individual owners, and the dependence of certain districts on the foreign demand were responsible. Only in the anthracite trade, which was highly concentrated in a small area in South Wales, was combination usual before 1914.

The chronic depression upon which the industry entered during the middle twenties gave a strong impetus towards the institution of market control, and in the later years of the decade several schemes were put into operation. The best known of them was the "Five Counties Scheme" to which the coal owners of the Midland counties subscribed. A basic tonnage for each member was determined and a quota applied each month to the basic figure. A subsidy of two shillings a ton was paid on exports of coal from the area, the money being raised by a levy of threepence a ton on the coal mined. The reason why the Midland owners were prepared to subsidize exports is to be found by considering the conditions of inter-regional competition. The loss of the export trade had led firms in Durham and elsewhere, who had previously been engaged in supplying foreign customers, to invade the inland market, and the Midland producers tried to compensate themselves for the losses in which this competition involved them by subsidizing exports. Marketing schemes were also brought into operation in Scotland and in South Wales.

These efforts to institute control over prices and output were strengthened by the Coal Mines Act of 1930. Part I of the Act dealt with the regulation of production and the control of sale, Part II provided for the establishment of a Commission to promote amalga-

mations, Part III repealed the Act of 1926 which restored the eight-hour day, and Part IV dealt with the creation of a National Industrial Board. The chief importance of the Act lay in its provisions for the limitation of output and for the control of minimum district prices. The owners in each district were entrusted with the task of formulating a scheme of regulation for submission to the Board of Trade, and a Central Council of colliery owners was established to fix quarterly production quotas for the different districts and to co-ordinate the work of the District Executive Boards. The various schemes as approved differed from one another in detail. But they all provided for the establishment of committees to determine the standard tonnage (based on output during a certain period) for each colliery, the proportion of the standard tonnage to be raised every month, and the minimum prices for different classes of coal. Penalties were imposed for production in excess of allocations and compensation paid on an ascertained deficiency. In their periodical revisions of the standard, the Executive Boards might take into account the relative efficiency of the various mines, and they might raise the standard for the growing mine and reduce it for the declining mine. Quotas were transferable among the owners in each district. The Act abolished the practice of subsidizing exports by levies on the tonnage raised.

The schemes that were put into operation were amended on several occasions during the thirties, always in the direction of eliminating the elements of competition that remained, and of imposing a more rigid control over the individual mine-owner. For instance, in the original Act the Central Council had no power to co-ordinate inter-district minimum prices, and in general the price-fixing powers of the District Boards were weakened by widespread evasion. The main trouble lay in the conflict of interest between exporting and inland districts.¹ The heavy fall in the foreign demand left the exporting areas with large excessive allocations and at the same time diverted their attention to the more profitable inland markets. Midland producers consequently suffered from the lower prices at which this coal was offered. The exporters claimed, however, that, on occasion, the restrictions were a serious handicap to them in their struggle for the fluctuating and highly competitive foreign markets. Therefore, they demanded additional allocations, or the formation of a pool of quotas on which they might draw for the purpose of meeting foreign demands. The inland districts opposed this claim

¹ J. H. Jones, *The Coal-mining Industry*, pp. 116-17.

on the ground that the additional allocations would probably be used for sales in the home market, and they proposed the co-ordination of district minimum prices in order to prevent this competition from the coastal areas. But the exporters replied that in view of their vulnerable position in foreign markets they must retain freedom in price-fixing. At last, in May 1934, an agreement was reached for a complete separation of inland and export allocations, so as to remove any restriction on the production of coal for export, and also for the co-ordination of inter-district minimum prices.

The next important step was taken in 1936, when the industry, under pressure from the Government, agreed to organize the marketing of coal in each district by establishing central selling organizations and by providing for the co-ordination of those bodies. Just as the original form of cartelization had been justified by appeal to the argument that, under unrestricted competition, the price at which coal could be sold was too low to give a reasonable level of wages and profits, so in 1936 the further advance towards a monopolistic structure was held to be the only means by which the industry could meet the demand then being made by the miners for higher wages. The schemes that were introduced were of three types. In Lancashire, Shropshire, South Staffordshire and the Forest of Dean colliery owners sold all their coal to a district board at an accounting price determined by prices paid in a past period. The District Boards then sold the coal as principals, and the profits or losses were divided among the colliery owners. Twelve districts, including Scotland, South Wales, Northumberland and Durham, adopted a system by which each owner sold his coal to his own customers but was subject to directions from a sales committee; this issued permits that prescribed tonnage, destination and minimum price. In the Midland district, collieries were formed into groups and the sale of coal by each group was controlled by an agent responsible to the District Executive Board.¹ The Central Council was at the same time given additional powers to supervise the district schemes. In other words, further concentration of control within districts was accompanied by a policy of increased centralization in the industry as a whole. In the fixing of prices, inter-district competition was further limited by the formation of joint committees for the discussion of pricing problems common to several districts. The fixing of prices for different classes of coal proved to be extremely difficult. Previously the scale of prices had been subject to frequent change in accordance with

¹ *Annual Report of the National Coal Board for 1947*, pp. 63-4.

movements in demand and supply. Now anomalies arose, as when on some occasions in South Wales, large coal for which too high a price had been fixed, was deliberately broken up. Discriminating monopoly also led to a situation in which ships were loaded with coal for export to Eire at one dock in the Mersey and then taken to another dock and discharged, in order to take advantage of the different prices fixed for other markets.

Prices rose after this new marketing organization began to operate, although, as demand was increasing at this time, it is impossible to say to what extent the rise can be attributed to the cartel. Few would deny that it had a considerable effect, especially as the organization of marketing that resulted was an essential preliminary to an international agreement between Great Britain and the highly organized industries of Europe. If it is contended that the main need of the industry was shelter, then that shelter was certainly provided by the action taken under Part I of the Coal Mines Act of 1930.¹

It is, however, more important to ask what effect the schemes had upon efficiency, for obviously resort to monopolistic price-fixing in itself was a mere palliative. There seems little doubt that the effect was unfortunate, and the fact that so little improvement in productivity occurred in the British industry at this time, when striking advances were being made abroad, is not without significance. One of the main defects was in the restrictions which the scheme placed on the development of particular mines. Since the conditions of economical operation differ from mine to mine, the imposition of an arbitrary limit to production, irrespective of those conditions, was harmful. For example, a large pit working with heavy fixed charges was prevented from producing that amount of output at which its costs were at a minimum.² Even though the Act gave owners the opportunity of acquiring the quotas of other mines in the same district, the purchase of these raised costs per ton; and the extension of the practice was handicapped by the fact that quotas were not transferable between districts. The application of an output-restriction scheme of this kind might be of financial advantage to an industry in a period of temporary depression. But it did nothing to help the coal trade to deal with its chronic problem of over-capacity, for it actually impeded the transference of production to the most efficient units.

¹ J. H. Jones, *op. cit.*, p. 379.

² The Coal Mines Reorganization Commission spoke of Part I of the Act as "having forced managers up against the problem of adjusting costs to stereotyped working below capacity." See C.M.R.C., *Report to the Secretary for Mines*, December 1933, p. 11.

When the Act was passed it was hoped that these schemes would ultimately be rendered superfluous by the development of large rationalized concerns, and the Coal Mines Reorganization Commission, established by Part II of the Act, was given the task of promoting amalgamations with this end in view. A tendency towards combination existed in the period before the Commission began its task, and the process of concentrating production on a smaller number of undertakings was slowly proceeding. In 1930 seven undertakings in South Wales and under twenty in Scotland controlled three-quarters of the output of those areas; while in Northumberland four undertakings and in Durham seven, were responsible for just over half the production. It seemed, therefore, that the Commission would be working with a recognized industrial trend. In fact, it achieved nothing of importance. At the beginning of its career it contented itself with the encouragement of voluntary schemes, but these efforts were unsuccessful except in a few districts. Attempts to enforce measures of compulsory amalgamation failed because of the opposition of the mine-owners and of the Commission's inadequate legal powers. It is true that the trend towards combination persisted up to the outbreak of the Second World War; but no single compulsory amalgamation scheme was carried through, and the Commission had to abandon its plans for a thoroughgoing reorganization of the industry. It is sometimes considered that, in the absence of fundamental alterations in the royalties system, the attempts of the Commission to bring about rationalization were doomed from the start. Legislation passed in 1938 attempted to deal with this deficiency, for it provided for the nationalization of royalties. At the same time it conferred on a new Coal Commission additional powers of effecting compulsory reorganization. The coming of war, however, prevented these latter powers from being tested.

After 1939 the industry again passed under Government control. The system of market allocations and arrangements under the 1930 Act continued in operation, but there was imposed on it a system of central administration, first by the Mines Department of the Board of Trade, and later by the Ministry of Fuel and Power. The details of this war-time control need not detain us; but the effect on the price and cost structure of the industry ought not to be ignored, for it had an enduring influence. From the early years of the war a Coal Charges Account was instituted. This was supplied with funds by a levy on tonnage mined, and it was used to equalize the effects

on proceeds of increases in costs. In effect, the inland districts were required to pay compensation to the coastal districts which had lost most of their trade because of the war. By 1945 Leicestershire, for example, was paying 7s. 8d. net a ton to the Charges Account from which Cumberland was drawing 10s. 8d. a ton and South Wales 6s. a ton to cover the amount by which their costs exceeded their proceeds.¹ While such a system might be justified in war-time, it was clearly pernicious in principle, since it destroyed any relation between earnings and efficiency.

VII

A Nationalized Industry

In the period from the abandonment of Government control after the First World War until the end of the Second World War, the coal industry had moved from a condition of free and, indeed, violent competition (though by no means perfect competition) through a system of private cartel agreements, officially imposed output- and price-control schemes and centralized marketing, to a system of war-time controls in which virtually no relationship existed between the costs of the individual mines and their financial returns, and in which the individual mine-owner had little or no control over his production and marketing policy. The last stage was reached in 1947 when, as a result of the Act of the previous year, the mines passed under public ownership. The political controversy over the merits of this step does not concern us; but it seems that nationalization was the logical outcome of the trend of the previous quarter of a century. In the grim years of depression the industry, like some others in the same position, had been unable to organize its contraction, and both the efficiency with which its operations were conducted and the standard of life of those working in it had suffered. Government-sponsored rationalization had failed. The remedy which the mine-owners sought and the Government of the thirties ultimately imposed was cartelization. This, however, was merely a means of providing relief and of improving the financial returns to the industry. Once the first steps in this direction had been taken, the way was clear for the conferment of a steadily increasing degree of monopoly on the producers. Cartelization, however, impeded rather than promoted the unification of control which, it was widely

¹ P.E.P., *The British Fuel and Power Industries*, p. 9.

believed, was necessary if the industry was to concentrate its production on the most efficient mines, and unification of control in private hands was hardly to be contemplated, especially as it was likely that the technical reorganization required would call for financial assistance from the State. While methods of State supervision which would have left the ownership of the industry in private hands were, of course, feasible, the demand for public ownership and control, for reasons other than those of efficient operation, both from the miners and from a large section of the public, meant that nationalization was the most obvious solution.

The Coal Mines Nationalization Act of 1946 set up a National Coal Board charged with the duty of providing for the efficient development of the industry and of making supplies of coal available "in such quantities and at such prices as might seem best calculated to further the public interest." These injunctions were vague in the extreme. Although the National Coal Board was required to balance its accounts on the average of good and bad years, specific directions upon such matters as price and development policy were absent from the Act. Moreover, certain responsibilities were retained by the Ministry of Fuel and Power; for instance, reorganization schemes that involved a substantial capital outlay needed the Minister's approval, and the industry was supposed to aim at an output target set by the Government.¹ This lack of precision in the definition of the Board's powers and objectives was to be expected. Since this was a novel venture, and since the circumstances of the time were abnormal, it was natural both that certain functions should be retained by the Government and also that the most expedient division of responsibilities between the Ministry and the National Coal Board should be left to the test of experience.

The mines were grouped for administrative purposes into eight Divisions, and elaborate regional and area organizations were established under the National Coal Board. Divisional Boards were set up to administer the regions, and under them the collieries were grouped into Areas, each of which was about the same size as the largest undertakings before nationalization.² The actual management of the mines was in the hands of Area General Managers, under whom worked the managers appointed for individual collieries. The

¹ Cf. A. Beacham, "The Present Position of the Coal Industry in Great Britain" in the *Economic Journal*, March 1950, pp. 10-11. In practice, the N.C.B. always secure the agreement of the Minister before raising prices.

² N.C.B., *Report and Accounts for 1947*, p. 1.

management of the industry was organized largely on a "functional" basis; that is to say, the chain of responsibility for particular management functions, such as marketing, finance and labour relations, passed from a specialist officer at the headquarters of the Coal Board down to corresponding officers in the Divisional organizations and from them to functional officers in the Areas.¹ Consequently, the authority of the Area General Manager was weaker than that exercised by his counterpart before nationalization, and this applied with even more force to the colliery managers themselves. It was not surprising that, in these circumstances, a charge of administrative over-centralization was levelled at the National Coal Board. But the Fleck Committee, which reported on the administration of the industry in 1955, found the chief defect to lie in the weakness of the functional links between the central departments and the Divisions rather than in any over-centralization.² It took the view that efficiency required that the Coal Board itself should exercise even stricter authority than hitherto over the Divisions and the Areas and that all major decisions should be taken centrally.

It remains to consider how the National Coal Board has discharged its duties. We have already referred to its failure to restore output to the pre-war level and to the consequences of this failure for the home consumers and the export market. The reasons are to be sought in several directions, most obviously in the shortage of manpower. In the early post-war years the difficulties encountered in rebuilding the labour force could be plausibly attributed both to the effects of the war itself and to the chronic depression of the thirties when many of the younger miners left the industry and the stream of new recruits to the labour market was diverted elsewhere. Whereas in 1937 only about 35 per cent of the miners were over 40 years of age, in 1948 the proportion was over 46 per cent.³ In these circumstances a high rate of recruitment was needed merely to offset retirements. The decline of ten per cent in the number of miners between then and 1956 and the fact that in the latter year the proportion of miners over 40 years of age had risen to 49 per cent are measures of the Board's failure in recruiting.⁴

What is the explanation? Undoubtedly the conditions of full employment that prevailed throughout the economy provided ample

¹ *Ibid.*, Organization Chart, p. 196.

² Ministry of Fuel and Power, *Advisory Committee on Organization*, *passim*.

³ Ministry of Fuel and Power, *Statistical Digest*, 1945, p. 21; and N.C.B., *Report and Accounts for 1949*, p. 259.

⁴ N.C.B., *Report and Accounts for 1956*, Vol. II, pp. 134-5.

opportunities for men in mining areas to find work in industries that offered more attractive conditions, and it is significant that, after 1950, the best years for recruitment were 1951-2, a period of depression especially in the textile trades, and 1956 when there was a recession in the motor industry. Yet it might be thought that sufficient labour would have been obtained by the offer of wages high enough to offset the attractions of other employment, and that the coal industry, faced as it was with an urgent demand for its products, could easily have afforded to pay what was required. Wages have in fact risen steeply in the coal industry since the war, and the miner is now much higher on the wage ladder than during the thirties. Nevertheless, it may be argued that the rise was inadequate and the further question must be posed as to why this was so. There are those who maintain that higher wage rates would have failed to overcome the labour shortage because wages had already reached the point at which many miners preferred more leisure to more money, and because additional pay would simply have resulted in an increase in voluntary absenteeism. That some miners would have responded in this way is very probable, but it is debatable whether they were sufficiently numerous to have invalidated the proposition that an adequate labour supply could have been obtained by an appropriate wage policy. It has also been contended that it would have been difficult to employ a substantially greater number of miners economically before large works of reconstruction and development had been completed. But such works themselves have been retarded by the shortage of labour. In fact, new development has been sacrificed, because of that shortage, to the necessity for satisfying immediate needs.

The National Coal Board was disinclined to seek a solution on these lines because of its reluctance to charge an economic price for coal. For overcoming the supply problem it put its faith in increases in productivity. By reorganizing the industry and by mechanizing mining processes it hoped to raise output to the level required without additions to the labour force. Its failure to realize these hopes lends support to the adverse criticisms of its price policy which have come from many quarters.

Before considering these criticisms we must first describe the actual process of price formation. During the war the rise in average costs was covered by flat rate increases in the prices of all types of coal. In consequence, at the end of the war, prices bore little relation to the relative demand for particular types of coal or to their costs. These

distortions continued for some time after the war. When the National Coal Board, having inherited this irrational price structure, began to address itself to the problem, it was faced with a non-competitive market subject to "rationing" and allocations. As a first approach, it made a physical classification of coal, based upon calorific value, ash content, size and other physical properties. But these properties, though very important, were not the only factors that influenced the demand for the different types of coal. The Board had also to take account of relative costs of production and relative costs of transport to the various markets. It therefore applied "coalfield adjustments" to the basic pithead prices determined by reference to physical properties. For example, Lancashire draws its supplies from the East Midlands as well as from the local field. Local coal consumed in Lancashire can naturally command a higher *pithead* price than that of coal produced in the East Midlands which must bear the costs of a long haul. The "coalfield adjustment" procedure recognized these facts by providing for additions to the basic price of Lancashire coal. Again, the pattern of coal prices has to be varied from time to time with changes in relative demands and costs. In 1954 the price of large coal, for which demand was then much in excess of supply at the existing level of prices, was increased relative to the price of small coal, and at the same time special increases were made in the price of Durham coking coal.

While the "coalfield adjustment" procedure was used to determine the average pithead price of coal sold to industrial consumers, household coal has been sold, irrespective of the source of supply, at a *delivered* price for every grade, a price which is uniform within each of sixty-four zones. This delivered price is determined by the average pithead cost and the average cost of transport for tonnages normally supplied from the various pits to all railway stations in any zone. If these methods of pricing should succeed in matching demand and supply for the different types of coal from different areas in the various markets, the conditions that would exist under free competition would then have been reproduced. But clearly this elaborate procedure would have been unnecessary if consumers had been free to buy their coal from the sources of supply that suited them best, and if prices had been allowed to rise so as to adjust supply and demand in the various markets. In fact, however, in the absence of any precise criterion of pricing furnished by Parliament, the Board has sought to keep prices as low as is compatible with the general direction to balance its total outgoings and receipts over a period of years.

The principle that prices should be based on average costs must, when applied to an increasing cost industry, result in the sale of large amounts of coal at prices lower than marginal cost. It was stated by the Chairman of the Coal Board that in 1951 one million tons of coal were being produced at a loss of 40s. a ton, seven million tons at a loss of 24s. a ton, and twelve million tons at a loss of 20s. a ton.¹ Certain members of the Ridley Committee asserted that marginal cost pricing alone could satisfy the claims of economic rationality, and they pointed out that average cost pricing must encourage the waste of scarce resources.² Other critics have suggested that while marginal cost pricing would be an irrelevant policy at a time when some part of the supply was being obtained from very high cost mines which would be closed as new capacity was brought into operation, prices should at any rate be raised to the point at which supply and long-run demand could be equated without rationing.³ The National Coal Board has gone some way to admitting that, ideally, prices should be such as to enable every undertaking to cover its costs, but its practice has been at variance with the principle. Although it has made adjustments in the prices of particular grades to accord with changes in the demand, it has been fearful of the effect on miners' wages and on managerial efficiency of the large profits which would result from charging an equilibrium price. Its objections to such a policy have not been removed by the suggestion that surplus revenue should be diverted to the Exchequer by an excise duty equivalent to the economic rent of the lower-cost mines, for it has been convinced that, with over-employment in the economy as a whole, higher profits, however described, would inevitably mean extravagant demands for wage increases which at the same time would be ineffective in attracting more labour. To the extent that the Board's arguments are valid, they can apply only to a period of continuing inflation and are indicative of the difficulty of pursuing a rational pricing policy in such conditions. As an alternative, the Board has placed its reliance upon administrative measures. It has tried to direct supplies to their most economical uses. It has closed down some of the least efficient mines and has transferred the displaced miners to others. A form of "rationing" was continued until the summer of 1958.

One of the main arguments for unification under State ownership

¹ Sir H. Houldsworth, *The Pits of Britain* (a paper read before the Manchester Statistical Society, February 13th, 1953).

² Committee on National Policy for the Use of Fuel and Power Resources, *op. cit.*, pp. 15-16.

³ I. M. D. Little, *The Price of Fuel*, pp. 6-10.

was that it would promote the rationalization of the industry and would permit a more economical distribution of capital for development than was possible when the industry was in many hands. Accordingly, the *Plan for Coal* announced in October 1950 proposed long-term schemes for development and reorganization. It estimated that in the period 1961-5 a production of 240 million tons a year of deep-mined coal would be required, of which 25 to 35 million tons would be sold in export markets and for foreign bunkers. A production plan was based upon these estimates. The output, one-fifth larger than in 1949, was to be produced by a labour force reduced by 80,000, and at a cost—at 1949 prices—7s. a ton lower. The rise in productivity needed to achieve these results was to be secured by the thoroughgoing reconstruction of the industry which would mean a gross investment of £635 million.¹ The main technical developments were to be those proposed in the Reid Report, namely the concentration of output on a smaller number of pits, the use of horizontal mining, power loading, locomotive haulage and improvements in winding. To achieve these technical advances, large structural changes were necessary. Of the 950 Coal Board collieries then in production, 350 to 400, with an annual output in 1949 of 50 million tons, were to close or to cease to have a separate existence. Seventy per cent of the future output was to come from about 250 collieries, which were to be the subject of major schemes of reconstruction, 10 per cent from some 22 new large collieries and about 53 new drift mines, and the rest from about 250 collieries which would continue in production without any important technical reconstruction. Thus, an output 20 per cent greater than that of 1949 was to be obtained from a much smaller number of mines (apart from drift mines, about 500 compared with 950) and from 11 per cent fewer workers. The higher productivity was to be the result of the elimination of high-cost pits, mechanization and various other improvements in methods of coal getting. At the same time the industry, being short of competent technical and managerial personnel, was required to institute elaborate training schemes, especially for mining engineers.

It was not expected that the major reconstructions would yield their results until towards the end of the period, for such schemes take many years to complete—over ten years for new sinkings and over eight years for major reconstructions.² However, even when this

¹ N.C.B., *Plan for Coal*, pp. 3-5. £115 million of this amount was to be spent on ancillary plant (coke-ovens, briquetting plants, etc.).

² N.C.B., *Investing in Coal*, p. 10.

delay was allowed for, it was clear by the middle fifties that the planned output would not be obtained. Progress in development was then behind schedule, and it was evident that, in the conditions of man-power shortage, preoccupation with immediate output had affected both the pace of development and the nature and locus of the expenditure.

The plan, therefore, had to be revised. A new forecast made in 1955 put the output in 1965 at only 230 million tons of deep-mined coal and the total expenditure between 1950 and 1965 at £1,350 million compared with £635 million in the original plan.¹ The increase in expenditure was explained partly by the rise in prices, partly by underestimates of the cost of the original schemes, but mainly by the need for additional new schemes to offset the constant loss of productive capacity. As to costs, it was thought that the benefits of the increased productivity which the new investment would make possible would be offset by the higher capital charges. Whether the forecasts will be realized depends not merely on the outcome of the major schemes of reconstruction but also on the success of the recruitment programme. The 1950 plan expected to get 250 million tons of coal with a labour force of 618,000 miners; the revised plan considers that the industry will need 682,000 miners, hardly fewer than at present, to achieve an output of 230 million tons. If the original plan overestimated the effect of the new schemes on productivity, the revised plan may well be guilty of excessive optimism in its judgment of the man-power likely to be available to the industry.

All the production in 1965, it is estimated, will be needed at home. Indeed the inland demand for coal (or coal equivalents) in 1965 is expected to reach over 300 million tons, 60 million tons more than the total estimated output of deep-mined and open-cast coal at that date. The deficiency will have to be supplied mainly from oil and nuclear power. It is clear that according to these forecasts no coal will be available for export. Any lingering illusions about the export capacity of the industry have at last been dispelled. Indeed it seems ludicrous that the British industry in recent years should have exported 10 to 14 million tons of coal annually at a time when home supplies have been so short that it has been necessary to bring coal expensively

¹ *Ibid.*, pp. 13 *et seq.* In addition to the deep-mined coal, it is expected that about 10 million tons of open-cast coal will be obtained. Of the total capital expenditure between 1950 and 1965, £206 million are required for ancillary activities.

from America. Exports, it is true, have been sold at prices that have averaged about £1 a ton more than those at which coal of similar grades has been sold at home. Yet since the Board has sold the imported coal at well below costs, the policy has involved it in heavy losses. The attempt to maintain exports is to be attributed chiefly to a reluctance finally to abandon traditional foreign markets and to vain hopes that output would recover sufficiently to meet all demands.

As we have seen, the change in the market situation in 1958 was such as to call in question many aspects of the Coal Plan. Whether substantial revisions will be required will depend on subsequent movements of industrial production as a whole and on the extent to which coal remains a successful competitor with other sources of power. If, moreover, the recession has underlined the dangers of a mistaken price structure, it has made it possible for the Board to pursue its policy for creating an economical industry with less friction than hitherto. The bearing of over-full employment on efficiency has been demonstrated by the fact that, with the decline in the demand for labour in the economy as a whole and in the mining industry in particular, mining productivity (output per man-shift) has risen sharply.¹

¹ Average output per man-shift (overall) was 1.25 tons in April–August 1958 compared with 1.22 tons in April–August 1957.

OUTPUT, EXPORTS AND EMPLOYMENT

Year	Output (in million tons)		Exports ¹ (including bunker coal for foreign- going ves- sels) (in million tons)	Employ- ment ² (in thou- sands)
	Saleable deep-mined coal	Open-cast coal		
1909-13 (av.)	270		88	—
1913 ...	287		98	1,127
1924 ...	267		85	1,230
1925 ...	243		72	1,118
1927 ...	251		72	1,037
1928 ...	238		72	952
1929 ...	258		82	970
1930 ...	244		75	943
1931 ...	219		62	877
1932 ...	209		57	827
1933 ...	208		57	797
1934 ...	221		57	798
1935 ...	222		56	759
1936 ...	228		50	756
1937 ...	240		56	778
1938 ...	227		46	782
1939 ...	231		47	766
1940 ...	224		27	749
1941 ...	206		9	698
1942 ...	204		8	709
1943 ...	195		8	708
1944 ...	184		6	710
1945 ...	175		9	709
1946 ...	181	9	10	697
1947 ...	187	10	6	711
1948 ...	198	12	17	724
1949 ...	203	13	21	720
1950 ...	204	12	20	687
1951 ...	212	11	13	699
1952 ...	214	12	17	716
1953 ...	213	12	19	713
1954 ...	214	10	18	707
1955 ...	210	11	16	704
1956 ...	210	12	13	703
1957 ...	210	14	11	710

¹ Exports include coal equivalent of coke and briquettes. The establishment of the Irish Free State as a separate customs area in 1923 affects slightly the comparison of the export figures before and after that date. In the twenties British coal exports to the Irish Free State were about 2½ million tons annually.

² These figures are not precisely comparable. Up to 1934 they show the esti-

AVERAGE OUTPUT PER MAN-SHIFT WORKED (OVERALL)¹
(in tons)

1935	...	...	...	1.17
1936	...	...	...	1.18
1937	...	...	...	1.17
1938	...	...	...	1.14
1945	...	...	...	1.00
1946	...	...	...	1.03
1947	...	...	...	1.07
1948	...	...	...	1.11
1949	...	...	...	1.16
1950	...	...	...	1.19
1951	...	...	...	1.21
1952	...	...	...	1.19
1953	...	...	...	1.21
1954	...	...	...	1.23
1955	...	...	...	1.23
1956	...	...	...	1.23
1957	...	...	...	1.23

INLAND CONSUMPTION OF COAL²
(in million tons)

				1938	1947	1955
Gas Works	...	...	...	19.1	22.7	28.0
Electricity Works	...	...	...	14.9	27.1	42.9
Coke Ovens	...	...	...	19.1	19.8	27.1
Railways	...	...	...	13.2	14.6	12.8
Collieries and Miners' Coal	...	...	...	16.5	16.1	13.7
Coastwise Bunkers	...	...	...	1.3	1.0	.6
Iron and Steel					8.7	6.5
Engineering					3.2	3.6
Other Industry				91.5	27.8	30.7
Domestic Consumption					31.6	32.5
Other					9.6	14.3
TOTAL	...	...	...	175.6	182.2	212.7

mated average numbers employed under The Coal Mines Act, 1911. From 1935 the figures are those in the Ministry of Fuel and Power series and show the average number of wage-earners on colliery books, excluding clerical and administrative staff. (For 1935 and subsequent years the employment given by the latter series is from 20,000 to 25,000 less than that given by the former series.) Slight alterations in methods of recording in 1946 had the effect of reducing the numbers on colliery books by about 2,500, and new definitions of manpower and attendance introduced in 1953 led to a further reduction of about 4,000.

¹ Source: *Monthly Digest of Statistics*.

² Source: *Annual Abstract of Statistics, 1956*.

CHAPTER IV

IRON AND STEEL

I

The History of the Industry to 1914

Some of the most striking changes in the industrial structure of Europe since the eighteenth century have been produced by the growth of the metallurgical trades. Of these, the iron and steel industry is by far the most important and it may, therefore, be regarded as one of the characteristic features of modern industrialism. The dependence of land and sea transport, of mechanical methods of production, of civil engineering and building on iron and steel needs no emphasis, and there was good ground for the nineteenth-century belief that a country's production of these commodities was a significant index of the stage of its economic development. The definition of an industry is seldom an easy task, and in the case of the iron and steel trade an exact demarcation of its functions is exceptionally difficult because of its close association with allied industries. From early times it has been affected by the movement towards vertical combination, which has been greatly strengthened during the last fifty years.¹ The industry stretches backwards towards coal and iron-stone mining and the coke-oven industry, and forwards to the engineering, shipbuilding, chemical and hardware trades. For the purpose of this survey, therefore, it is necessary to define the iron and steel industry in a somewhat arbitrary fashion. The activities to be considered are, first, the production of pig iron, with some reference to the problems of ore and coke supply, second, the production of wrought iron and steel, and finally, in less detail, the manufacture of the more highly finished products, such as tinplate, galvanized sheets, tubes, wire, forgings, castings and railway material. The following table shows the numbers engaged in the leading branches of the industry in October 1957.

¹ The nationalization of the coal industry has reversed this tendency in Great Britain to the extent that it has deprived iron and steel firms of the ownership of coal-mines.

EMPLOYMENT

Numbers at work in the Iron and Steel Industry¹

Process Workers:

Iron Ore Mines and Quarries	...	...	...	...	4,370
Coke Ovens at Blast Furnaces	...	...	...	...	4,830
Blast Furnaces and Sintering Plants	...	...	...	...	12,500
Steel Melting Furnaces and Ancillary Processes (excl. melting for manufacture of steel castings)	...	...	...	...	22,910
Rolling Mills and Ancillary Processes (excl. wrought iron, sheet and tin-plate rolling, but incl. bright bars)	...	...	...	...	47,680
Sheet Mills (incl. hot continuous wide strip mills)	...	...	...	...	15,560
Tinplate Manufacture	...	...	...	...	6,680
Forges and Ancillary Processes (other than drop forges)	...	...	...	...	6,540
Steel Foundries and Ancillary Processes (incl. melting for manufacture of steel castings)	...	...	...	...	20,090
Wrought Iron Manufacture	1,110
Steel Tubes, Pipes and Fittings Manufacture	21,280

TOTAL	163,550
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General and Maintenance Workers associated with above processes

Administrative, Technical and Clerical Workers associated with above processes	93,460
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TOTAL	302,750
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Iron Foundries	137,520
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GRAND TOTAL	440,270
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The diagram shown on p. 94 illustrates the relation between the different sections of the trade from the point of view of its technical processes.

We propose, in the first place, to trace the history of the industry in outline during the last two centuries. This will help to explain how its present structure developed. It will also show that the magnitude, organization and location of the industry have been repeatedly and vitally affected by the discovery, from time to time, of new processes of production. In this respect the industry may be contrasted with the cotton trade, where the fundamental inventions of the eighteenth century have since received wider application and improvement, but have not been swept aside by other far-reaching technical changes.

¹ Source: *Monthly Statistics of Iron and Steel Board*, October 1957.

IRON ORE, COAL or COKE, and LIMESTONE¹ are charged into a

BLAST FURNACE

This produces

NDRY PIG IRON
s is melted in
foundry

CUPOLA

converted into

ON CASTINGS
stoves, ranges,
baths, etc.)

(types of castings,
ALL IRON CASTINGS,
de from hematite
pig iron

STEELMAKING PIG IRON
(hematite or basic)

This is converted into
ACID or BASIC STEEL in the

BESSEMER CONVERTER

OPEN-HEARTH FURNACE

ELECTRIC FURNACE

These furnaces produce

STEEL INGOTS

These are
treated in the

COGGING MILL

where they are formed into
BILLETS, BLOOMS and SLABS

The Steel then passes to the

FORGING PRESS

for manufacture into
FORGINGS

or to the

FINISHING MILL

where it is converted into
PLATES, SHEETS, RAILS, ANGLES,
GIRDERS, WIRE RODS, ETC.

SCRAP MATERIAL
is also used in the

FORGE PIG IRON
This is used in a

PUDDLING FURNACE

and is converted into

PUDDLED BARS

These pass through the

FINISHING MILL

which produces

WROUGHT IRON
in various forms

¹ Based on a diagram in *Committee on Industry and Trade, Survey of Metal Industries*, p. 2.
(By permission of the Controller of H.M. Stationery Office.)

Before the eighteenth century the smelting of ore took place in small charcoal-fired furnaces which were naturally situated in districts abundantly supplied with ore and timber, such as Sussex, the Forest of Dean, South Staffordshire and South Wales. Productive methods were purely empirical and the output of the furnaces consisted of a bloom usually composed of a core of iron with a shell of steel. The iron core was either cast into moulds or treated under the hammer to render it malleable. Since the latter half of the sixteenth century restrictions had been imposed by law on the number and location of the furnaces, because of the destruction of timber resulting from their activities. These restrictions, together with the exhaustion of the fuel supplies in the older centres, gradually gave rise to changes in the location of the furnaces and forced them to move from Sussex and the West Midlands towards Wales, where timber supplies still remained. This tendency to increased dispersion on the part of its primary branch was characteristic of the industry as a whole in the early eighteenth century. The forges and mills engaged in the manufacture of the finished iron products were seldom found in close proximity to one another or to the smelting furnaces; for the mills were drawn to situations in which water-power was available, while the smiths operated their forges in the neighbourhood of easily accessible coal. To an increasing extent the finishing sections of the trade at this time were becoming dependent on foreign supplies of iron imported from Sweden, Norway, Spain and Russia.

These conditions of production, together with the increasing demand for iron, provided a stimulus to the discovery of an alternative fuel, and the application of pit coal in the form of coke to the smelting of ore was successfully worked out by three generations of the Darbys, ironmasters of Coalbrookdale, Shropshire. The pig iron produced in these new blast-furnaces proved more suitable than charcoal iron for the manufacture of light cast utensils, such as cooking-pots, and the latter part of the eighteenth century saw an expansion of the foundry trade and the appearance of several new branches, such as the cast-iron hollow-ware industry. During the same period a second fundamental discovery was made. Up to the last quarter of the eighteenth century malleable iron could only be produced from pig slowly and laboriously under the hammer. But in 1783-4 Henry Cort perfected a coal-fired reverberatory furnace, known as a puddling furnace, in which the pig was melted and stirred to rid it of impurities, and he also introduced grooved rolls through which the puddled iron was passed. These processes reduced the

cost of malleable iron by accelerating the rate of production and by enabling a cheaper fuel to be used. A further step was taken in 1790 when Homfray of Tredegar devised the refinery, or running-out fire, in which the surplus silicon was removed from the pig before it was treated in the puddling furnace. Whereas in Cort's original process two tons of pig were required to make a ton of wrought-iron bars, the use of the refinery reduced the amount to between 30 and 35 cwt. The inventions of Cort and Homfray created the malleable-iron period, 1784-1875, during which Great Britain was the predominant producing country.¹

The application of these new metallurgical processes occurred at a time when James Watt's steam-engine was being introduced into the mining and manufacturing industries of the country. The ironmasters had first used the old Newcomen engine to raise the water by which their blowing apparatus was worked; but Watt's engine was more efficient, and by 1800 it was superseding the less reliable water-power, not only in the blast-furnaces themselves, but for many of the secondary processes, such as rolling. These discoveries enabled the British ironmasters to meet the increasing need for iron which occurred at the birth of modern industrialism, and to satisfy the great munitions demand after 1793. The output of pig rose from 68,000 tons in 1788 to nearly 260,000 tons in 1806.² After the war the growth was maintained by the introduction of a multitude of new uses for iron and by an increase, especially after 1825, of the export trade. By 1830 it was estimated that the annual British output had risen to 650,000 or 700,000 tons.³ The new method of production altered profoundly the location of the industry. By 1830 the iron trade had been freed from its dependence on water-power and timber supplies and was becoming concentrated in those districts which possessed resources of iron ore and accessible coking coal. Dispersion had given place to a high degree of concentration. Of the total output of pig iron about two-fifths came from South Wales and about one-third from Staffordshire. The wrought-iron trade, also, was localized mainly in those two centres.

Meanwhile, the older empirical methods of steel production had been abandoned in favour of new processes which made possible the production of high-grade material of known quality. Benjamin Huntsman worked out the crucible process for making cast steel

¹ H. Scrivenor, *History of the Iron Trade* (1854), pp. 252-3; cf. T. S. Ashton, *Iron and Steel in the Industrial Revolution*, Chap. IV.

² H. Scrivenor, *op. cit.*, pp. 87-8, 99.

³ *Ibid.*, p. 136.

about 1740, and about the same time the production of shear steel was introduced into this country. Until the last quarter of the eighteenth century England continued to depend on foreign supplies of steel; but by the end of the Napoleonic Wars Sheffield had become the centre of the steel trade and was exporting to the Continent.¹ The introduction of these steels enabled new metal-working tools to be manufactured and so stimulated many iron-using trades, such as engineering.

Subsequent technical discoveries in the iron industry were mainly connected with the problem of fuel economy. During the twenties many detailed improvements were effected in English blast-furnace practice, especially by the South Staffordshire ironmasters; but it was in Scotland that the most revolutionary changes occurred. The Scottish iron industry had been handicapped by the difficulty of reducing the local "black-band" iron-stone with the Lanark coal, which was of a non-coking variety. Between 1828 and 1831, however, J. B. Neilson found that raw coal could be used to smelt the local ores, provided that the furnace blast was heated.² On this discovery was based a great Scottish iron industry which, from small beginnings in 1830, rose to rival those of South Wales and Staffordshire a quarter of a century later. The hot-blast resulted in smaller fuel economies in England, where the coal and ore were of different qualities. In spite of an initial prejudice against it, however, it was gradually introduced and is now almost universally employed, although for certain types of wrought iron and castings cold-blast pig is still preferred. The economies which the hot-blast made possible are shown by the fact that whereas in the eighteen-twenties more than eight tons of coal were required to produce a ton of pig iron, with the adoption of the hot-blast and an increase in the size of the furnaces this consumption was reduced by the early fifties to just over two tons. Neilson's invention also made possible the use of anthracite for smelting and so led ultimately to the rise of a great iron industry in the United States, where, to the south of Lake Superior, vast resources of ore were found along with anthracite supplies. A further saving of fuel was effected when, in 1845, Budd of Ystalyfera in the Swansea valley devised a method by which the hot gases generated during the smelting process might be employed to heat the blast, instead of being burned wastefully above the furnace. As a result, a new type of furnace with a closed top gradually

¹ J. H. Clapham, *An Economic History of Modern Britain, 1820-1850*, p. 149.

² H. Scrivenor, *op. cit.*, pp. 260-4.

came into use as the hot-blast was more widely adopted; but in the early eighties there were still many blast-furnaces making no use of this economy.

In the wrought-iron branch of the trade two inventions of major importance were made before the middle of the century. One of these was the work of Joseph Hall of South Staffordshire and led to a great improvement in the puddling furnace. The older type of furnace was wasteful, since its sand bottom absorbed a considerable quantity of metal during the puddling process. Hall used a bed called "bulldog," made of a substance rich in iron oxide, in order to prevent this waste. His new process, known as "pig-boiling," was worked out between 1825 and 1832, and it enabled the South Staffordshire manufacturers "to make by a single operation from pig of any reasonable composition, and therefore cheaply, a bar of a quality superior to that produced by the two or three operations commonly employed in South Wales and other districts."¹ The other important innovation was the steam hammer invented by Nasmyth in 1839. This was widely used during the next decade for "shingling," i.e. removing the scale and slag from the balls of iron in their passage from the puddling furnace to the rolling mill.

The period from 1830 to 1870 witnessed a huge increase in the "make" of iron. The output of pig rose from about 700,000 tons a year in 1830 to an annual average production of 3,800,000 in 1859-61, and to over 6,500,000 tons in the boom of 1871-3. This great increase was associated largely with railway developments and, after 1850, with the construction of iron steamships; while a number of new products were introduced, such as galvanized sheets. Exports grew rapidly, especially after the middle of the century; for the world was dependent on Great Britain for supplies of finished iron for transport equipment. Down to 1860 the output of Germany, France and the United States remained small, and charcoal furnaces were still numerous in Continental countries whose industrial advance had been checked by political troubles. Only Belgium kept pace with Great Britain in industrial development, and Belgium was too small to be a serious rival. Even as late as 1870 British supremacy in this industry seemed unassailable.

The growth of output during this period had called new producing areas into existence. The rise of Scotland has already been discussed. By 1857 its output was as great as that of the older centres,

¹ J. W. Hall, "The Life and Work of Joseph Hall," reprinted from the *Proceedings of the Staffordshire Iron and Steel Institute*, p. 15.

South Wales and the West Midlands. These three districts then produced about three-quarters of the total output of pig iron. Other centres were, however, growing fast. In 1851 the North-east Coast was opened up, and a combination of advantages, viz. the coking coal of Durham, supplies of easily smelted Cleveland ore and proximity to the sea at a time when the export trade and shipbuilding were growing, gave it, by 1872, a leading position. In that year it produced 29 per cent of the British output. The West Midlands, South Wales and Scotland, where the ore resources were failing, were each responsible in 1872 for about 16 per cent.¹ Other centres, such as the West Riding, Lancashire and Cumberland, were also advancing about this time. The development of the last two districts is to be explained, in part, by the revolutionary changes in steel manufacture which were shortly to alter the whole technique and organization of the industry.

In 1856 Sir Henry Bessemer described a method of converting molten pig iron into steel without the use of additional fuel. Carbon and silicon could be burned out of the metal by a blast of air blown through it when in a converter, and the requisite quantity of carbon could then be restored in the form of ferro-manganese or spiegeleisen. The process was a rapid one and only took between twenty and forty minutes, in contrast with the laborious and protracted puddling process. The product had specially valuable qualities. Whereas wrought iron is a fibrous and heterogeneous material, having its strength mainly in one direction, steel is crystalline and homogeneous, having its strength in all directions.² The latter, therefore, proved far more suitable than wrought iron for such products as rails, boiler plates and other commodities subjected to great strain when in use, and Bessemer steel began to be employed for these purposes during the early sixties. By 1869 another process of steel-making had become established. This was the Siemens-Martin, or open-hearth process, which differed from the Bessemer process in details to be described later.

The change-over from wrought iron to steel was not, of course, immediate. Many of the metal-using trades were suspicious of the innovation, and smiths and other iron-workers had to accustom themselves to use of the new metal. The ironmasters had great

¹ Sources of statistical data: *Mineral Statistics* (Home Office) to 1896; *Mines and Quarries Reports*, 1897-1920; National Federation of Iron and Steel Manufacturers, *Statistics of the Iron and Steel Industries*, 1930.

² Cf. W. J. Ashley, *British Industries*, pp. 15-16.

quantities of capital invested in their wrought-iron plants, and few of them could be expected to take up steel manufacture, for which the initial outlay was expensive, until forced to do so by the pressure of circumstances. Another disadvantage common to both the Bessemer and the open-hearth processes was that only iron made from ores with a low phosphorus content could be used for steel-making, since phosphorus was not eliminated in the furnaces, and its presence in substantial quantities injured the quality of the product. By far the greater part of the world's supply of ore was phosphoric and the application of the new processes was, therefore, limited.¹ For these reasons the output of steel remained small during the sixties and wrought-iron production continued to expand, reaching its zenith in the boom which accompanied the Franco-Prussian War of 1870-1. This marked the culmination of the wrought-iron age. With the beginning of the "great depression" in 1874, the wrought-iron trade entered upon a long period of decline, and it could be said that the steel age had begun.² This country was relatively well-equipped for developing the new steel industry. The supply of British non-phosphoric ores was confined to the hematite of Lancashire and Cumberland, where a large iron and steel industry arose after this time; but Great Britain was in a position to import the non-phosphoric ores of Spain and Sweden more cheaply than other industrial nations, owing to her superiority in shipping and to her coal export trade. Dependence on foreign supplies steadily grew until, in 1913, about one-half of the British iron output was made from imported ores. This change in the source of raw-material supplies increased the importance of a site near the sea for the iron and steel producers, and partly for this reason the industry began to move after 1860 from the older Midland centres to coastal districts.

The supersession of wrought iron was hastened by the discovery in 1879 of the basic process. Gilchrist and Thomas then showed that if the Bessemer converter, or the open-hearth furnace, were provided with a lining of some basic material, this would take up the phos-

¹ The high charge for patentee's licences, in addition to the expensiveness of the Bessemer ore, "made the early steel plate or rail much dearer than its iron competitor," and long endurance tests were necessary "to prove that the dearer material was really the more economical." J. H. Clapham, *An Economic History of Modern Britain, 1850-86*, p. 56.

² The "great depression" may be said to have lasted from 1874 to 1886 with a short interval of active trade in 1880-2. The wrought-iron output, after falling in the middle and late seventies, appears to have risen in 1881-2 to a level approaching that of the boom years (1870-2); but from 1883 onwards there was a steady decline.

phorus from the iron during conversion, so that steel of good quality could be produced from phosphoric ores. Steel made in this way was known as basic steel (Bessemer or open-hearth), in contrast with acid steel produced by the earlier processes. As there were ample supplies of cheap phosphoric ores in Great Britain and elsewhere, an opportunity was thus given for an expansion of steel-making. Among British engineers, however, a prejudice existed against basic steel, since its quality in the Bessemer converter, where it was first produced, was difficult to control. Even when the process was applied to the open-hearth furnace, in which there was more opportunity for testing and control, acid steel still continued to enjoy a better reputation for reliability. Its use was prescribed for constructional engineering, shipbuilding, and railway tyres and axles; and because of the great importance in this country of customers who required high-grade material there was a strong inducement to preserve the acid process. But mild steel (i.e. steel low in carbon content) made by the basic process was highly suitable for many purposes previously served by wrought iron. It was cheaper and it lent itself more readily to manipulation by presses and machine tools. Consequently, its use spread rapidly during the nineties for the manufacture of galvanized sheets, tinplate and a multitude of small metal products. During the early years of the present century its importance continued to increase. In 1901 only 17 per cent of the British steel output was of the basic variety; by 1913 the proportion had risen to 37 per cent. The change was a symptom of the weakening of the prejudice against basic steel on the one hand and, on the other, of the increasing supersession of wrought iron. By this time wrought iron, which forty years earlier had been the staple raw material of the metal-using trades, had become merely a speciality. Where corrosion was to be feared, or where there was special danger of "fatigue," wrought iron was still preferred, and it continued to be employed for ship's cables, anchors, bunker plates and for certain types of tubes. But for most other uses steel had taken its place.

The thirty years before the First World War saw the introduction of several other classes of steel in addition to those described. The old crucible method was still employed for the manufacture of high-grade cast steel; but during the nineties the electric furnace began to be used for the production of special steel. Before 1914, however, it was confined almost entirely to countries poor in coal but rich in water-power. Of more immediate importance were the discoveries

of the special alloy steels themselves. These included manganese, silicon, chromium and nickel steels, all of which have qualities suiting them for special purposes. Perhaps the most important of all were the high-speed tool steels; for these encouraged the mechanization of the metal trades, and so, by cheapening production, led to an immensely increased demand for ordinary qualities of steel. The table on page 131 discloses another tendency in steel production during this period, viz. the steady increase in the relative importance of open-hearth as compared with Bessemer steel. In the early eighties, the output of the latter type amounted to three-quarters of the total; but in 1894 open-hearth steel took the lead and it formed in 1913 nearly four-fifths of the total British output. This change was due, in part, to peculiarities in the home demand for steel and to technical factors. But it was also connected with the growth in other countries of competitive steel industries which enforced specialization on Great Britain.

Technically, the open-hearth process has an advantage over the Bessemer process in that it gives greater opportunities for testing the metal by samples taken during conversion, and consequently open-hearth steel is regarded as the more reliable type. As an exceptionally large proportion of the British demand was for high-quality steel, it was natural that the British industry should have a bias to the open-hearth process. Again, as the open-hearth furnace can be charged with a much larger proportion of scrap than the Bessemer converter, it was particularly suited to conditions in Great Britain where abundant scrap was available at low prices from the numerous finishing trades.¹ On the other hand, the Bessemer process, being much shorter than its rival, is less extravagant in fuel consumption and is, therefore, on the whole, cheaper; but this advantage was not as substantial in Great Britain, with its cheap fuel supplies, as elsewhere.

The supersession of the Bessemer process in England, however, cannot be fully understood without reference to developments abroad. Up to the middle seventies Great Britain had enjoyed a large export trade to the United States. America then began to develop her own resources of ore and coal and, by the end of the "great depression," that market had been lost to the British producers. In 1890 the American steel output exceeded the British and by 1913 it was four times as great. But the steel was of a very different kind from that produced by Great Britain. Whereas this country's output was for the most part acid open-hearth steel, two-thirds of

¹ Committee on Industry and Trade, *Survey of Metal Industries*, p. 3.

the American production consisted of basic open-hearth and one-third of acid Bessemer steel. Conditions in Germany were somewhat similar. Before 1880 she had imported large quantities of hematite iron from Britain for steel-making, as her own ores in Lorraine could not be employed for that purpose. The discovery of the basic process, however, caused an immediate revolution. Germany abandoned the acid for the basic process and overtook this country as a steel producer in 1893. By 1913 the German output was more than twice the British. The Lorraine ores, rich in phosphorus, proved highly suitable for the basic Bessemer process, and in 1913 well over half the German output was produced in the converter, most of the remainder being basic open-hearth steel. If these foreign developments are compared with the British, the divergent courses of the leading steel industries become evident. The rise of the great Bessemer industries in America and Germany cut short the development of that branch of the British trade, and forced this country to concentrate on the manufacture of high-quality steel produced in the open-hearth, particularly the acid open-hearth, furnace.¹

Thus the "great depression," coinciding as it did with the transition from wrought iron to steel, marked the end of Great Britain's predominant position in the iron and steel trade. Her output, it is true, continued to increase; but she was overtaken by the rapid advance of Germany and the United States, and from a position of supremacy in the seventies she was reduced to the third place in 1913. In that year these three countries were together responsible for 87 per cent of the world's pig iron and 75 per cent of the world's steel output.² The relative decline in the British position was bound to occur as soon as other countries developed their superior natural resources. But it was hastened by technical changes. The organization required by the industry after the coming of steel differed from that suited to the wrought-iron era. Whereas the wrought-iron trade was largely a manual process and depended on the skill of experienced workers, success in steel production was bound up with the scale of output and the ability of the trained metallurgist. Moreover, in addition to the fundamental inventions, a number of detailed improvements in processes were made during the last years of the nineteenth century, and of these the newer producing countries were able to

¹ Departmental Committee on the Iron and Steel Trades, *Report* (Cmd. 9071), 1918, p. 5.

² *Survey of Metal Industries*, pp. 113, 114.

take full advantage. Thus the by-product-recovery oven for the production of metallurgical coke came into use after 1880, just when the Continental pig-iron industry was expanding, and practically all the coke output of the Ruhr in 1913 was manufactured in plants of that kind. But when the new type of oven came into existence Great Britain had nearly reached the limit of her expansion as a producer of iron, and her coke-oven plant could not easily be remodelled. In 1913, two-thirds of her ovens were of the old type.¹ During this period it was found to be economical to place the coke-ovens, blast-furnaces and steel works in close proximity, since the iron could then pass in a molten condition from the blast-furnaces to the steel furnaces, while blast-furnace and coke-oven gas could be employed in internal-combustion engines to generate electricity for operating the rolling mills. Countries just entering the field could organize their industry on these lines; but Great Britain was handicapped by her old plant which, in situation and construction, was more suited to the iron than to the steel age.

The conditions of the British raw-material supplies also changed to the disadvantage of the iron and steel industry. That industry had been specially favoured in its early days by the low cost of coal. During the years following 1880, however, not only were the ore supplies in many of the older fields giving out, but the cost of coal-mining was rising. It has been shown that the price of coal rose relative to the general price level up to 1900-4, and this tended to raise the prices of pig iron and steel. At the same time improvements in technique were working in the opposite direction; but the Balfour Committee concluded that these improvements were not sufficient in all branches of the iron and steel industry to overcome the effects upon price of the rise in the cost of fuel.² During the same period Germany and America were only just beginning to work their raw material resources, which were abundant.

The rise of new producing countries checked the expansion of the British export trade, and the tonnage of iron and steel exports actually declined to a slight extent between 1880 and the end of the century. In 1880 the value of these exports had been twice that of the combined exports of the United States, France and Germany; but twenty years later German exports alone were only slightly less than those of Great Britain. With the great expansion of international trade after 1900, British exports rose from an annual average of 3,312,000 tons, valued at £29 million in 1900-4, to 4,747,000 tons,

¹ *Ibid.*, p. 24.

² *Survey of Metal Industries*, p. 10.

valued at £48 million in 1910-13. These figures do not, of course, cover exports of ships and engineering products, which also expanded rapidly after 1900. Yet, partly in consequence of the systematic dumping policy of the *Stahlwerksverband*, German exports increased still more rapidly and exceeded those of Great Britain in value in 1912 and 1913. American exports also rose at a greater rate than those of Great Britain after 1900, but their value was still substantially less than that of the British exports in 1913. The British iron and steel export trade is difficult to analyse because of the great variety of products in various stages of manufacture that fall within its scope; but the prevailing tendencies after 1870 may thus be summarized. Exports of pig iron remained large though stationary. There was a decline in exports of finished iron, owing to its displacement by steel, and of railway material on account of foreign competition; but a new trade in steel bars and sections developed and there was a great increase in the exports of sheets, tinplate and tubes. Part of this trade was based on imported semi-manufactured steel. The development of this import trade was significant. Sporadic imports, particularly from Belgium, had occurred even before 1870; but it was not until after 1895 that they became substantial. They were associated with the expansion of the basic steel industries of Germany, Luxembourg and Belgium, and the greater part of the imports, which rose from an annual average of about 500,000 tons in 1895-9 to 1,849,000 tons in 1910-13, consisted of basic semi-products (ingots, blooms, billets, wire- and sheet-bars).¹ The Continent, by producing cheap basic Bessemer steel on a large scale, was able to undersell British makers who were concentrating on higher grades of steel and on finishing processes.

This historical survey throws light on the essential instability of this industry. It shows that a position of apparently unchallengeable supremacy may be undermined in a short space of time by technical changes which destroy the relative advantages of some producing areas and confer leadership on others. The discoveries of Darby and Cort transferred predominance in this industry from countries with large timber resources to England with her abundant coal supplies. The hot-blast, within a few years of its introduction, created a great Scottish iron trade. The inventions of Bessemer and Siemens destroyed the importance of South Staffordshire as a producing centre and brought about the migration of the industry to coastal areas. The Thomas process enabled the vast ore supplies of Lorraine,

¹ *Survey of Metal Industries*, pp. 122-3.

previously of little account, to be employed for steel-making and so made Germany the chief European producer. The coming of far-reaching changes in technical methods is often a moment of danger for an old-established producing area or country. This retains its experience and skill and usually its access to various external economies of production. But the foundations of its previous supremacy may be undermined and, except by accident, it is unlikely to possess the same relative natural advantages for the new technique as for the old. Its personnel may be handicapped, moreover, by conservatism bred of a long experience in the successful application of older methods.

II

Depression and Recovery, 1920-39

The demand for munitions after 1914 exercised a profound influence on the iron and steel trades in all parts of the world. The chief belligerent states greatly increased their capacity, and countries in which production had previously been small or non-existent established plants to supply their own needs. Consequently, when the world boom came to an end in 1920, productive capacity was far greater than it had been in 1914. In Great Britain alone it is estimated that blast-furnace capacity rose from 11 to 12 million tons and steel capacity from 8 to over 12 million tons.¹ With the advent of the post-war depression, accompanied as it was by financial disturbances, the impoverishment of Central Europe and the inability of the great lending centres to supply capital on the pre-war scale to new countries, the world's demand for iron and steel was checked. Whereas in the decade prior to the war the world output of steel had doubled and that of pig iron had increased by two-thirds, in 1924-5 the world output of pig was distinctly less than in 1913, and that of steel was only slightly greater. Continental Europe and Great Britain were the chief sufferers. While the American production, especially of steel, had made a considerable advance, the output of the leading Continental producers (Germany, France, Belgium, Luxemburg and the Saar) was 11 per cent less than before the war in pig iron and 7 per cent less in steel. The steel output of Great Britain was equal to that of 1913; but her pig-iron production had dropped by one-third. After 1924-5 world output recovered. In

¹ *Ibid.*, p. 18.

pig-iron production the United States made a great advance, and the western Continental group in 1929 turned out 23 per cent more than in 1913. The British production on the other hand was stationary after 1924. In steel, American production increased enormously; that of the Continental group in 1929 was 36 per cent greater than in 1913; while the British output was only 26 per cent greater. Thus, up to 1924-5, Britain may be said to have been affected by troubles common to all European iron and steel producers. But in the period of European recovery from 1924 to 1929 her pig-iron trade, unlike theirs, failed to revive, and she shared only to a moderate extent in the expansion of the European steel output. Her plant throughout this period was forced to work at half its capacity; the insured labour force contracted by 10 per cent between 1924 and 1930; unemployment was very heavy, and profits were low. The industries of other countries also suffered from the excess of world capacity after 1920; but, as in the coal trade, Great Britain was the principal victim.

For this, several causes were responsible. First, there was a deflection of world demand from those classes of materials which Great Britain was best fitted to produce to others in which her relative advantages were fewer. Second, in the industry as a whole, British costs were high in comparison with those of her competitors. The first point may be illustrated by reference to the changes which occurred in the output of different classes of iron and steel. In the world as a whole steel production increased at a much greater rate than pig-iron production, so that whereas in 1913 the latter was in excess of the former, during the post-war decade the position was reversed. This change was caused partly by the substitution of steel for wrought and cast iron, and partly by the increased use of scrap in open-hearth furnaces and foundry cupolas. The war left behind a huge quantity of scrap material, and the technique of steel production was adapted to this condition of supply. For example, in Great Britain the proportion of scrap charged into the steel furnaces rose from 30 per cent in 1910-13 to 50 per cent during the twenties.¹ A second change was the advance of the basic process. In America this resulted from the progress of the open-hearth process at the expense of the acid Bessemer process. On the Continent, where even before 1914 the bulk of the steel output was basic, the predominance of this type was strengthened. There was also a tendency

¹ M. S. Birkett, "The Iron and Steel Industry since the War" in the *Journal of the Royal Statistical Society* (Part III), 1930, p. 346.

for the basic open-hearth to gain on the Bessemer process; although the latter was still responsible for a large proportion of the Continental output, particularly in France. In Britain a more striking change took place. The preponderance of the acid open-hearth process was destroyed, and in 1929 more than two-thirds of the total steel output was produced in the basic open-hearth. The acid Bessemer output by then had fallen to 6 per cent of the total, and practically no basic Bessemer steel was produced. In all countries the electric furnace increased in importance.

Thus the two most marked changes were the relative decline of iron and the advance of basic steel. The effect of these changes on Great Britain may now be examined. Before 1914 this country produced 1,207,000 tons of puddled bar iron. By 1929 the output had fallen to 158,000 tons owing to the displacement of wrought iron by basic steel. This represented a loss to Great Britain of a line in which she was previously supreme. The decline of the wrought-iron trade, in turn, adversely affected those blast-furnaces which produced forge iron; while a similar transference of demand from cast iron to basic steel reduced the demand for foundry iron. The demand for acid steel, in the production of which Great Britain had peculiar advantages, declined through the depression prevailing among the chief users of this metal, such as shipbuilders and manufacturers of railway equipment. A more important reason, however, lay in the substitution of basic for acid steel. The quality of basic steel improved, the original prejudice against it diminished, and it became used for many purposes for which acid steel was once prescribed. This decline in the demand for acid steel, as for forge and foundry iron, was common to all countries. But Great Britain was in the unfortunate position of having concentrated on these types, and she had fewer advantages than Continental producers for the manufacture of the cheap basic steel. The full force of these changes is best illustrated by the movements of foreign trade.

Between 1910-13 and 1927-9 the annual average quantity of iron and steel exports from Great Britain declined from 4,747,000 to 4,279,000 tons.¹ Since iron and steel exports comprise many different classes of materials, it is not possible to estimate the significance of the change until they have been examined in detail. In the years before 1914 nearly one-quarter of the tonnage of the British exports

¹ The inclusion of trade with the Irish Free State among the foreign trade returns after 1923 exaggerates, for purposes of comparison, the last figure by between 2 and 3 per cent.

consisted of pig iron and ferro-alloys. These products were shipped mainly to Continental Europe, although there was also an export trade to India, Japan, and South America. The greater part of the iron was forge, foundry and acid steel-making pig, much of which was produced from imported ores. Great Britain was in a favourable position for conducting the trade. The iron and steel producers of the Continent had little non-phosphoric ore, nor were their coalfields situated in coastal areas. This country, however, having her coalfields near the sea, was able to assemble raw materials and to ship the pig abroad cheaply. The advantage did not apply to basic pig; for the Continental producers had ample supplies of good basic ores and they had little need to import basic iron. In the most favourable year of the twenties the British foreign trade in pig iron was only half as great as before 1914, and the main loss was occasioned by the fall in exports of forge and foundry pig to the Continent. The loss was due mainly to the substitution of basic steel for wrought and cast iron to which reference has already been made. In distant markets the British loss was caused by increased production in such countries as India and Japan, and by the establishment of blast-furnaces in countries which were not previously producers of pig iron.

If pig is excluded, then the tonnage of exports in 1927-9 was about the same as before 1914. The greater part of this residue consisted of highly finished products of which galvanized and other sheets, tinplate, steel bars, pipes, tubes and railway material were the most important. The leading markets for these products, unlike those for pig iron, were outside Europe, and the British Empire was chief among them. Considerable changes occurred in the relative importance of the various finished manufactures. While exports of railway material diminished, sales of sheets, plates and tubes were greater than in the early years of the century. The decline in the value of the British export trade was not as great as the tonnage figures suggested, since the loss consisted mainly of low-priced products, especially pig iron. Yet, while Great Britain suffered most severely from the effects of the diminished world demand for the latter class of material, she did not succeed in winning a sufficiently large share of the increased trade in other products to balance her losses.

To some extent the expansion of the sheet trade was made possible only by the employment of foreign supplies of cheap crude steel. Under conditions of free international exchange most manufacturing countries are likely to import a considerable quantity of iron

and steel. The more highly developed a country's economic life, the greater will be the variety of qualities and types required by it, and none can hope to produce economically all the varieties. Thus, Great Britain both exported and imported large quantities of iron and steel. But in the period between 1913 and 1929, while exports fell, imports substantially increased. The bulk of these imports consisted of semi-manufactured steel employed by the British finishing industries; the largest items were steel blooms and billets used in the rolling mills, and sheet and tinplate bars for the galvanized sheet and tinplate trades. Imports of these materials greatly increased after 1914, as did rolled products like wire rods, steel bars, girders and beams, hoops and strips, all of which formed the raw material for British firms in "higher" stages of the iron and steel trade. Nearly nine-tenths of the imports came from four countries, Belgium, Luxemburg, France and Germany; and a great part of them consisted of steel manufactured by the basic Bessemer process.

Under the most favourable conditions of supply Britain would have been forced, as a result of the changes in demand, to make greater adjustments in her iron and steel industry than other countries in order to maintain her relative importance. That she was unable to do this is an indication that her costs were too high in those classes of materials for which demand increased and in which Continental countries were most active competitors. Part of Britain's relative disadvantage in costs was due, as already pointed out, to the superiority of the Continent in its resources of ores suitable for the production of basic steel. Part was due to the inevitable difficulties of adjustment experienced by a country which had long abandoned the cheaper Bessemer process. But certain other adverse influences might have been avoided.

During the twenties the British producers were inclined to attribute their difficulties in international competition either to Governmental policy or to fortuitous events that favoured the Continental producers. Thus, they pointed to the inflation in Germany, France and Belgium which ended in either a complete reconstruction or a devaluation of the currency. This, they rightly claimed, reduced the burden of indebtedness on the steel firms and stimulated their exports. In Great Britain the post-war deflation and the return to the gold standard in 1925 at pre-war parity had had a contrary effect. At the same time, Continental industries, damaged by the war, had been re-equipped with Governmental help. It is true that in 1929 the British producers also were favoured by derating and by excep-

tionally low freight rates on coke; but this help was on a comparatively small scale. Finally, labour costs were raised in Great Britain by the general adoption of the eight-hour day, for this required a three-shift system of working compared with the two-shift system before 1914. Although the Continental steel industries also formally adopted the same system, in fact it was less rigidly applied.

While no one denied the influence of these factors, critics were not prepared to admit that they were of pre-eminent importance. The Committee on Civil Research, 1930, was insistent upon the need for fundamental reorganization if the Continental superiority was to be removed.¹ It was impressed with the amount of inadequate and antiquated plant in the British industry, especially in the smelting and coke-making branches, and it advocated regional amalgamations as a necessary preliminary to re-equipment and increased specialization. It considered also that the Thomas process should be revived, since it was from the products of the Continental basic Bessemer furnaces that the keenest competition in the British market came. Other critics, while agreeing with the necessity for consolidation on the ground that competition was too imperfect to lead either to the elimination of high-cost producers or to the necessary specialization of plants, suggested that one of the leading causes of the British weakness was the unsatisfactory location even of the major producing units. What was needed, they thought, was a reconstitution of a large part of the industry on the newer ore-fields, especially in Northamptonshire, for it was in the cost of assembling raw materials that the British firms showed the most marked inferiority to their competitors. Regional consolidation might even impede a re-location of the industry towards which tentative steps were at that time being taken.²

The world depression of 1929-32 fell with crushing force on the iron and steel industry. A steep fall in output during the downward phase of the trade cycle is likely to be experienced by an industry whose main customers are producers of capital goods; but British iron and steel production suffered also at this time from the competition of imports supplied by Continental producers who were themselves engulfed in depression. Consequently, the home production of pig iron dropped between 1929 and 1932 by 53 per cent and the production of steel by 45 per cent. At this time the industry appeared to be near to a complete collapse. Yet when revival came in 1933 it

¹ D. L. Burn, *The Economic History of Steelmaking, 1867-1939*, pp. 436-7.

² *Ibid.*, pp. 441-2, and *passim*.

was very rapid, and by 1935 steel output had exceeded that of 1929, hitherto the best year. By 1937, the boom year of the thirties, steel output was nearly 13 million tons, more than a third greater than in 1929. Recovery in the pig-iron output was also substantial, although it was not until 1936 that the 1929 output was exceeded, and then only slightly. The increased use of scrap in the steel furnaces and the continued slump in the pig-iron exports were mainly responsible for the slower recovery of this branch of the industry.

The revival of the industry was associated with the recovery of shipbuilding and of constructional engineering in general, the expansion of the motor industry, the substitution of steel for timber in coal-mining, and finally, rearmament. But the development in Great Britain cannot be fully understood without some reference to the special influences that affected foreign trade. From April 1932 a tariff of 33½ per cent *ad valorem* was imposed on imports of many classes of iron and steel products; and after 1935, when the British industry reached an agreement with the European Steel Cartel, imports were further limited by quota. The result was that, throughout the recovery years of the decade, imports remained at a comparatively low level. In 1933 they were 970,000 tons, only one-third of the 1929 imports, and even when British consumption of steel rose above that of the twenties, as it did in 1937, imports were still less than in 1929¹. The chief reductions took place in crude steel and in sheet and tinplate bars.

The British export trade showed no corresponding revival. From 4,380,000 tons in 1929 it had fallen to 1,887,000 in 1932, and even in the best of the subsequent years (1937) it reached only 2,609,000 tons. In this respect the British industry shared the experience of other producers, for international trade in steel was sluggish during this decade. The main losses sustained by the British industry were in pig iron, galvanized sheets, plates and sheets, rails and steel bars. Thus the thirties brought about not only a reduction of those exports that had been declining before 1929 (such as pig iron), but also of exports of the more highly finished goods that had expanded during the twenties.

The revival of British production in the thirties was attended by an improvement in Britain's relative position as an iron and steel producer. The British share of the world output of steel had fallen

¹ Imports of iron and steel into Great Britain amounted to 1,152,000 tons in 1935, 1,483,000 tons in 1936 and 2,039,000 tons in 1937. In 1929 the imports were 2,822,000 tons and in 1931 2,852,000 tons.

from 10.2 per cent in 1913 to 8.1 per cent in 1929 and 7.6 per cent in 1931. By 1937 it had risen to 9.7 per cent. This relative improvement was due in part to the slow recovery of output in the United States and in Continental Europe after the World Depression. Moreover, merely because Great Britain was such a large importer before 1932, her import restrictions after that date caused a strongly marked diversion of demand to her own producers at the expense of former supplying countries. The total weight of output, however, is not the only measure of success. The protection of British industry from Continental imports of crude steel and semi-products reversed a tendency which had been prominent in the twenties and brought important structural changes to the industry. Up to 1932 the cheapness of Continental crude and semi-finished steel had damaged the primary branches of the British industry, and had confined growth to the finishing trades which depended on these cheap imports. The partial exclusion of Continental steel from the British market after 1932 stimulated the branches that manufactured ingot steel and semi-products; but the finishers no longer had a wide choice of suppliers and their costs were raised. For instance, the re-rollers were unfavourably affected, and so were the producers of galvanized sheets and tinplate. Moreover, Continental producers of tinplate bars, which they had formerly exported to Great Britain, now sought an outlet for their products by taking up the manufacture of the finished goods themselves. This explains why during the middle thirties Continental exports of galvanized sheets and tinplate rose, while British exports of these products fell. The price of revival in the heavy branches of the iron and steel industry was thus paid in lower exports of highly valued products and in dearer materials for all the multifarious trades which use steel. The British motor industry, when considering its inferiority to the American, found one cause in the higher price which it was required to pay for steel. These matters can, however, best be considered in connection with the changes in organization that occurred in the years before the Second World War, and the subsequent development of the industry will be described in section IV.

III

Problems of Organization

From the time when the iron industry became concentrated on the coalfields it has been conducted in large units, and even in the early nineteenth century concerns with great capital and with hundreds of employees were common. Nor was it unusual to find among these early producers instances of an integrated structure. Many firms mined their own ore and coal, produced pig iron in their own blast-furnaces and finished iron in their own forges and mills, and in some instances actually went on to manufacture engineering or hardware products. With the rise of the new steel industry the forces making for an increase in the size of the business unit were strengthened "by the magnitude of the aggregate volume of the homogeneous fluid material which has to be produced, and by the magnitude of the individual masses to be handled."¹ Large blast-furnaces do not employ as much coke, nor as many men, nor do they cost as much originally, in proportion to the iron produced, as small furnaces. Similarly in the mill branch, economies may be effected in a large establishment because each section specializes on metal of a certain type and gauge, and frequent changes of rolls are avoided. Certain overhead expenses, such as the capital and maintenance cost of travelling cranes, fall less heavily on the unit of output if the size of the works is large. "Further, there is no other group of industries in which the higher and lower stages work for one another so steadily and on so large a scale; and therefore there is no other group in which large lateral extensions and amalgamations are so likely to be accompanied by large vertical extensions and amalgamations. Iron and coal-mines at the 'lowest stage' are large users of the rails and the machinery which come from the higher stages: the smelting furnaces receive from the mines at the lowest stage and pass on their products to the heavy mills: which, like all the rest, are large consumers of high-class machinery."²

We have already seen that great technical economies may be realized by the establishment of coke-ovens, blast-furnaces, steel furnaces and mills in juxtaposition. Fuel may be saved if the pig can be passed in a molten condition from the blast-furnaces to the steel furnaces and if the steel can be taken hot from the latter to the mills; while the gases generated in the coke-ovens and blast-furnaces

¹ Marshall, *Industry and Trade*, p. 219.

² *Ibid.*, p. 219.

may be utilized for converting pig into steel in open-hearth furnaces and for driving the mill plant. By-products, such as basic slag, can also be made into marketable commodities by firms so organized. The fact that the market prices of the raw materials are unstable is a strong inducement to a firm to acquire its own mines, since this facilitates control over costs. A steel producer may also seek to strengthen his market position by acquiring shipyards or engineering plants. At the same time, the integrated firm may expect that adverse movements of trade will not affect with equal severity all its branches, and even in a period of general depression, some sections may be occupied in providing others with necessary equipment or with repairs.

Some doubts have been expressed whether vertical integration, except in so far as it is associated with the technical economies available to adjacent plants engaged on successive stages of production, is as cost-saving as is often claimed. It has been urged that backward integration, to give one example, is often to be attributed to a wish to escape from the exactions of monopoly on the part of the suppliers of materials, and that under conditions of competition the advantages of integration would be fewer. To admit this, however, is not to deny the benefits to particular firms of an integrated structure in the conditions that exist in the iron and steel and allied industries. The benefits may sometimes be strategic rather than economic. Yet in industries that work with heavy fixed capital, especially those confronted by an unstable demand, firms are normally less concerned with maximizing their net profit in the short run than with achieving security over a long period. The criticism is, therefore, hardly relevant to the practices of a particular industry and can only be sustained, if at all, in the wider context of economic policy as a whole.

The trend towards vertical integration was strengthened after the First World War, and this was matched by an increasing concentration of output in the main classes of product. By 1930, 70 per cent of the total British output of iron and steel was turned out by twenty firms, and in 1932 ten vertical groups had 47 per cent of the pig-iron capacity and 60 per cent of the steel capacity.¹ In other countries concentration had gone even further. The twenty British firms had an output of steel less than one-third of that of the United States Steel Corporation, slightly less than that of the Bethlehem Steel

¹ "Mass Production of Iron and Steel" in *The Times*, May 15th, 1930; and *Economist*, January 2nd, 1932.

Corporation and about the same as the Vereinigte Stahlwerke. The two American producers then had 55 per cent of the total United States capacity and in Germany five producers controlled 70 per cent.¹ Some of the regional amalgamations which took place in the later twenties and early thirties in Great Britain resulted from pressure from the banks to which the firms were indebted, and the Bank of England took a hand in promoting the movement. It cannot be said, however, that these amalgamations led to the creation of an obviously more efficient structure. They had some effect in providing for regional specialization, but they did little to bring about the better location of plants. For many firms the chief results were the reconstruction of their capitalization, which had been inflated during the years before 1920, and a regrouping of properties.

The typical plant, as well as the typical firm, was smaller in Great Britain than among her chief competitors. Although, for example, the average annual output per blast-furnace rose in this country from 30,000 tons in 1913 to 48,000 tons in 1929 and to 83,000 tons in 1937, yet even so the British blast-furnace on the eve of the Second World War was small compared with the American, with its annual average of 210,000 tons, and the German with 125,000 tons. Similar contrasts could be found in the steel furnaces of the three countries. In technical organization the British industry remained less closely knit than the foreign. For instance, since in Great Britain many blast-furnaces producing steel-making pig iron operated in situations remote from the steelworks, the practice of supplying molten metal to the steel furnaces advanced less rapidly than on the Continent. Even here there was a strong tendency in this direction during the inter-war period, and other technical advances were not lacking. They were undertaken, as were most technical improvements in this industry, with fuel economies in view, and there was, in fact, a fall in coke consumption per ton of pig iron from 28.4 cwt. in 1920 to 25 cwt. in 1929. But similar improvements were effected on the Continent, and so the gap between British and foreign costs remained as wide as before.²

Disappointment with the results of the so-called rationalization movement as it affected the British iron and steel industry provoked some critics to question whether the tendency towards consolidation was to be applauded. They had little difficulty in showing that the combination movement on the Continent, which the British producers had been urged to emulate, had often been brought about for

¹ M. S. Birkett, *loc. cit.*, pp. 361, 369.

² D. L. Burn, *op. cit.*, p. 434.

reasons that had little to do with technical or commercial efficiency, and that even where costs had been an important factor, it could be argued that the circumstances which had made the consolidation desirable were absent in this country. In some cases the emergence of giant concerns in Europe depended upon geographical or geological accident (such as the concentration of mineral resources), on fiscal policy (since in a protected home market conditions are favourable for a policy of price maintenance by monopolies), on financial conditions (for after the stabilization of the German currency the shortage of working capital induced firms to amalgamate in order to strengthen their appeal to foreign investors) and on the territorial changes brought about by the Peace Treaty (for this, by splitting up a homogeneous economic region, forced structural changes on the firms affected).

These objections to the appropriateness of foreign example are powerful. Yet they do not really touch the case for British consolidation which had to be argued on its own merits. The case rested on the contention that the larger British firms were insufficiently specialized, and that only by a policy that covered the whole industry could the necessary changes be brought about; for competition, being very imperfect, could not achieve this in a reasonable time. On the other hand, if, as seems likely, regional consolidation impeded locational change, and if such a change be considered essential for efficient production, then the movement which in fact occurred had serious demerits. Another line of criticism proceeded from the dismal assumption that Great Britain had lost for good her former advantages in turning out the common kinds of iron and steel which are most cheaply produced in large plants. Consequently, since she could never hope to compete successfully with the Continental producers favoured with cheap ores, she would be well advised to concentrate on the manufacture of specialities, for which small firms and small plants are well suited, and on finishing operations. This, of course, was to accept the necessity for a steep and permanent contraction of the primary branches of the industry. Such a solution was repudiated by those who were convinced that, given the right kind of reorganization and re-location on the new ore-fields, the British industry was capable of meeting Continental competition in bulk lines.

During the thirties the problem was shifted to a new plane by the intervention of the Government, moved by considerations of mass unemployment and strategy, and subsequently the conditions of

international competition were completely altered by the Second World War. In the spring of 1932 the iron and steel industry, on which the depreciation of sterling had already conferred a benefit, was brought under the shelter of a high protective tariff. The circumstances that attended this momentous change in fiscal policy must be described. In its approach to the Import Duties Advisory Committee, a committee representing 70 per cent of the steel production of the country denied that a tariff would mean higher prices for domestic consumers, and it promised that, should shelter be given, improvements in technique and organization would follow.¹ I.D.A.C. recommended that a temporary duty of 33½ per cent *ad valorem* should be imposed on many classes of iron and steel, and that this should be renewed provided that satisfactory reorganization schemes were brought forward. On the acceptance of the recommendation by the Government, the industry proceeded to confer on the question of reorganization. The first important outcome was the strengthening of central organization by the creation of the British Iron and Steel Federation with a chairman drawn from outside the industry. The Federation's nominal functions were very wide, but at first its main duties were to foster the reorganization schemes proposed by the various sectional associations that were affiliated to it, and to represent the industry in its discussions with the Import Duties Advisory Committee.

These discussions covered a wide range of topics that lay at the heart of economic policy, and the two bodies in association became responsible for fixing prices, controlling competition, subsidizing high-cost producers and supervising the development plans of individual firms. How far the British Iron and Steel Federation in fact possessed the authority over the industry that is sometimes attributed to it is difficult for an outsider to judge. Undoubtedly the Federation was susceptible to the opinions of the sectional associations which the new organization greatly strengthened, and the "common voice" with which the industry was now able to speak did not always drown the discordant murmurs of its members. But it is clear that from this time onwards questions of economic policy in the industry were settled by political negotiation rather than by market pressures, which, of course, had been relieved by the monopoly powers conferred. In the exercise of its functions the British Iron and Steel Federation

¹ See *Iron and Steel Reorganization Scheme: Correspondence Between the National Committee for the Iron and Steel Industry and the Import Duties Advisory Committee* (1933).

was formally subject to the supervision of the Import Duties Advisory Committee which was supposed to ensure that the public interest was served. In the political climate of the period, however, the public interest, as then defined, had little relationship to the supremacy of comparative cost criteria in determining the direction of development and the sources from which production should be obtained. Thus, a blessing was given to the mischievous system of uniform delivered prices irrespective of the location of the customer, and this removed the incentive for a steel user to save transport charges by settling himself in the neighbourhood of his suppliers. Again, the industry's promise that protection would not bring higher prices led, as raw-material prices recovered, not to the transference of output to the low-cost producers, but rather to a system of "stabilized prices" by which high-cost producers were subsidized out of levies raised from the industry as a whole. The Federation instituted a joint buying scheme for scrap, and when the price of this material increased in 1937, it arranged to spread the effect over the whole industry by a pooling scheme. This meant that those producers who used little scrap and much pig iron in their furnaces were penalized. It was also detrimental to the pig-iron industry and discouraged technical improvements in a branch of the trade notoriously in need of them. To the protection already conferred by the tariff, there was added in 1935 a quantitative limitation on imports as a result of an agreement between the British Iron and Steel Federation and the European Steel Cartel. In order to obtain this agreement in face of dissatisfaction with its proposed terms on the part of the European steel producers, the Government raised the tariff until the import limitation was accepted, and thus conferred on the British industry security from foreign competition in the home market.

The new system of administration was scarcely more satisfactory in the field of reorganization than in that of price policy. Since the country was now committed to a policy of producing at home the bulk of the steel that it required, irrespective of the comparative cost of imports, it might have been expected that the Government would have exerted pressure to ensure the development of low-cost capacity and the abandonment of high-cost capacity. But the principles of plant specialization and of re-location on the British ore-fields were only tentatively applied. It is true that the most important new venture of the thirties—the integrated steel and tube works at Corby—was situated on the Northamptonshire ore-fields, and that in this project the Thomas process of steel manufacture, which had died

out in Great Britain, was revived. It is also true that there was heavy investment in new plant during the later thirties and that this raised the average level of efficiency. But many of the new plants were badly sited and did little to promote the use of cheap home ores. In some instances political considerations were allowed to divert them from the most economical situations. For example, the proposal to build a continuous-strip mill for making tinplate and sheets in Lincolnshire, where costs would probably have been low, was rejected, and the plant was erected on a much less suitable site at Ebbw Vale. This decision was taken because of the Government's concern with unemployment in South Wales. Again, while there were further consolidations in the thirties, they were not accompanied in general by any pronounced tendency towards greater plant specialization.

During the Second World War the industry passed under Government control and its operations were governed by strategic needs. It became impossible even to provide adequately for the maintenance of existing plants and the only new capacity installed was that required for specialized war products. The supervision of prices was transferred from I.D.A.C. to the Ministry of Supply and later to the Iron and Steel Board. Firms were obliged to continue their former practice of submitting statements of costs, and uniform delivered prices were fixed. This system was continued after the war with minor modifications, and many of the objectionable practices of pre-war days were retained. For instance, the system of uniform delivered prices continued. Further, with the object of keeping down steel prices, imports of scrap were subsidized by the Government, and high-cost producers were given financial support from funds collected by levies on the industry as a whole. The relation between costs of production and prices was thus further obscured.

IV

Reconstruction and Expansion after 1945

The recent history of the industry demonstrates the hazards of attempting to forecast developments in economic life. During the thirties the competitive position of the industry had become very weak and certain branches of it were even threatened with extinction. In 1945 a period of remarkable achievement began and twelve years later production reached a level four-fifths greater than in 1936-8.

What is more, the industry in the post-war period found itself able to turn out steel at prices lower than those ruling in any other country. The course of this development must be described.

The end of the war confronted the industry and the government with two major issues; first, the amount and kind of new equipment needed for the creation of an up-to-date industry, and second, the methods of organization and control. At the request of the government, the British Iron and Steel Federation prepared a reconstruction plan which was presented to the Ministry of Supply in 1946 and was accepted, in substance, as indicating the lines on which re-equipment should proceed.¹ The plan, which was to be carried out in from five to seven and a half years, aimed at expanding the capacity of the steel industry from 14 million to 16 million tons; this meant an increase in actual production from 12 $\frac{3}{4}$ million tons in 1946 to 15 or 15 $\frac{1}{2}$ million tons on the completion of the plan. The expansion was to be brought about by creating new steel-making capacity of 6 million tons, of which 4 million tons was for replacing existing plant. It was assumed that there would be an import of about 500,000 tons a year. For pig iron, 4 $\frac{3}{4}$ million tons of new capacity was to be built, including 3 million tons to replace existing plant. The expansion of production was to be widely spread over the steel-making areas, and the only decreases allowed for in the plan were in the North-west Coast and Staffordshire. The largest net increases were planned for Northamptonshire and Lincolnshire, which were to get about three-fifths of the *net* increase; but this still left the greater part of the new steel capacity to be provided in the older districts that depended on scrap or imported ores, especially the North-east Coast and Scotland. The plan was criticized on the ground that too much was conceded to the older high-cost centres of production, and that the opportunity to expand output in the areas of cheap home ore supplies was neglected. (This locational problem will be discussed further in section V.) Provision was also made for increased specialization. Rails were to be produced at four plants instead of eleven; the number of steel plants in the North-east Coast was to be reduced from nine to five, and each survivor was to specialize on a particular main product; and in South Wales a very few hot strip mills and cold reduction plants were to replace the bulk of the small hand-mills in the sheet and tinplate industry.

The active demand for steel meant that the plan soon had to be

¹ Ministry of Supply, *Report of the British Iron and Steel Federation and Joint Iron Foundry Council on the Iron and Steel Industry*.

revised, at first chiefly by delaying the scrapping of old capacity. The plan itself was completed ahead of schedule. By 1949 the output of steel had already reached $15\frac{1}{2}$ million tons and that of pig iron $9\frac{1}{2}$ million tons. In 1952 the respective amounts were $16\frac{1}{4}$ million and $10\frac{3}{4}$ million tons. A second development plan was then worked out. This was designed to produce an output of $20\frac{1}{2}$ million tons of steel and 15 million tons of pig iron by 1957-8.¹ The continued buoyancy of demand led to upward revisions of these figures also. By 1957 the schemes approved or under consideration provided for the creation by 1962 or 1963 of a steel capacity of 29 million and pig-iron capacity of 19 million tons.² A larger capacity for the manufacture of finished steel products was also planned. If these schemes are carried through, the industry by 1962 will be equipped for an annual production nearly three times that of 1938.

Meanwhile, in this country as elsewhere, technique has advanced. In the manufacture of pig iron, improvements have been effected through new methods of preparing ore, including the increased use of sinter. Sinter is produced by the combustion of coke in a mixture of ore "fines" and other iron-bearing substances, materials that would otherwise be wasted. Its use has led to reductions in fuel consumption in the blast-furnaces. In steel-making, the use of an oxygen blast has brought considerable economies, especially in the Bessemer process. In the finished steel branches, the introduction of continuous mills for rolling sheet and strip, billets and other products have brought savings in fuel and labour.³ The substitution of oil for coal in a number of finished steel works is another important post-war innovation.⁴

At the same time the optimum size of the technical unit in most branches of the industry has tended to increase and the plants built since the war have a much larger capacity than the old ones. For instance, the blast-furnaces constructed in the early fifties had a capacity two or three times greater than the national average at that time.⁵ When the present development plan has been carried through, the typical blast-furnace will have a 20-22 foot range or a 26-28 foot

¹ Sir Ellis Hunter, "The Steel Industry in 1954" in *National Provincial Bank Review*, February 1954, pp. 3-4.

² Iron and Steel Board, *Development in the Iron and Steel Industry, Special Report (1957)*, pp. 33, 47.

³ *Ibid.*, pp. 78-85.

⁴ The increased use of oil is the main cause of the fall in the consumption of non-coking coal by the industry since the war, in spite of the steep rise in the production of finished steel.

⁵ Anglo-American Council on Productivity, *Report on Iron and Steel*, p. 17.

range compared with a 14-16 foot range in 1945.¹ The size of the typical open-hearth furnace and of the Bessemer converter has also grown considerably, and this tendency will be carried further in the next few years. For these and other reasons, the pre-war trend towards the concentration of output of bulk steel on a few large works has persisted. The Anglo-American Productivity Team reported that in an integrated steel works, economies could be progressively realized until output reached 750,000 or a million ingot tons a year. As in 1950 the average capacity of the 40 British works then making bulk steel was only 325,000 tons a year, the optimum size was still far from being achieved, and it is recognized that even in 1962 some obsolete works are likely to be in production.²

One must, however, avoid equating size with efficiency in all circumstances. Nor can it be assumed that technical change will always be on the side of the giant works. For example, experiments are now being made with the continuous casting of steel into billets, blooms or slabs, instead of into ingots which subsequently require rolling into the required forms. If these experiments are successful, the advantages of the very large plants may be reduced, especially since the Bessemer converter using an oxygen blast would be an ideal companion for the continuous casting machines. Similarly an increased use of the electric furnace for common grades of steel (which would become economical if cheap scrap and electricity were available) would mean that small works could hold their own.³ Small works are, of course, particularly well-adapted for the production of special steels or of sections required only in moderate quantities. It is most unlikely that small re-rolling plants will be entirely superseded.

Yet, despite the place that still exists for the small plant and firm, on the whole the trend in recent years has been towards consolidation and the concentration of control in a very few large groups. This movement is closely associated with the technical changes that have favoured the production of finished steel in vertically integrated works. For example, the tinplate industry, which a short time ago was a distinct branch of manufacture conducted by numerous firms with some 200 works, has by now almost lost its separate character. Tinplate has become one of a number of end-products

¹ Iron and Steel Board, *op. cit.*, p. 78.

² Anglo-American Council on Productivity, *op. cit.*, p. 17.

³ E. T. Sara, "Progress in the United Kingdom Iron and Steel Industry" in *Yorkshire Bulletin of Economic and Social Research*, May, 1957, pp. 50-1.

of three giant plants which integrate the main processes of iron and steel manufacture. The old hand-mills are almost extinct.

The post-war changes in equipment and organization required very heavy investment, and between 1945 and 1956 about £500 million were invested (apart from expenditure on care and maintenance). Some of the results of this additional investment manifested themselves in notable increases in labour productivity; these are among the chief causes of the relatively low British costs. By 1956 the volume of output per man-year was about 50 per cent higher than in 1937.¹

The advances in output and efficiency are all the more remarkable because the industry has been exposed, to an exceptional degree, to the vagaries of public policy. Immediately after the war official supervision of the industry was effected through an Iron and Steel Board appointed by the Ministry of Supply. This was intended merely as an interim form of control, and in 1949 an Act was passed which provided for the nationalization of a large part of the industry. Difficulties of definition made the type of nationalization adopted for other trades unsuitable for iron and steel. So the government established a Corporation to take over, by the purchase of shares, a list of firms selected according to their importance as producers of primary iron and steel goods. Hardly had ownership been acquired, when a change of government brought about a revolution in policy and a process of denationalization was set in train. It was recognized, however, that in so basic an industry, where it was difficult, if not impossible, to assure the protection of the public interest that is elsewhere provided by a competitive market, some measure of public supervision had to be maintained. By an Act of 1953, therefore, a new Iron and Steel Board, appointed by the Ministry of Supply, was set up with powers to determine the home trade prices of most classes of iron and steel and also to regulate capital development. This represented, with some modifications, a return to the methods of I.D.A.C.

As before the war, some of the results of public supervision over the industry's price policy have been of questionable advantage, and the practices followed require further discussion. The pricing arrangements of the industry, in conjunction with the operation of the Industry Fund (which is supplied by a levy on ingots produced), have certainly contributed towards keeping prices stable and at a

¹ The British Iron and Steel Federation Index of Labour Productivity (1938 = 100) shows a rise from 116 in 1937 (a boom year) to 139 in 1950 and to 169 in 1956.

lower level than in other countries. Maximum prices for each class of goods have been determined by the average costs incurred by their various producers,¹ a system that involves compensation payments, through the Industry Fund, from low-cost to high-cost producers. But the prices so determined have left the supply and demand for the goods unbalanced, and to meet this problem, elaborate controls have been devised. For instance, the low home prices fixed for finished and semi-finished steel have made it profitable to export these products. As a result, in order to ensure adequate supplies to the British engineering industry, direct exports have been restricted either by edict or informal agreement. In the home market steel rationing was continued for many years after the war, and even when it was abolished, an informal system of allocating steel continued. Furthermore, the price disparities compelled the industry to operate a central buying organization for importing pig-iron, scrap and ingots. This organization distributed these products at prices comparable with the lower home prices and met the difference from the Industry Fund. Similarly, imports of ore through the central organization were often distributed to the iron producers at a loss. Again, since the ratio of scrap iron to pig iron prices as fixed by the Board was below the physical rate of substitution between the materials, it was necessary to prevent an excessive demand for scrap on the part of the steel-makers. Consequently, scrap bought by steel makers was charged with a levy which was paid over to the users of pig-iron.²

The disadvantage of these methods is that market prices, by ceasing to reflect accurately the costs incurred in the use of alternative materials or processes, are liable to distort business decisions and even to bias the organization of an industry. When low-cost producers are levied to assist high-cost producers, one of the incentives to adopt cost-reducing methods is removed. Again, the joint arrangement for the purchase and distribution of scrap gives an artificial encouragement to vertically integrated firms because these can make use of their own scrap as they please, whereas specialist producers have to sell scrap at low controlled prices or to buy scrap at a price that includes a levy.

The price arrangements, the control over exports and the joint purchase of certain imports mean that the volume of international trade in iron and steel products bears little relation to what it would reach in a free market. In fact, during the middle fifties, both the

¹ Excluding a range of the highest cost producers.

² Cf. L. Foldes, "Iron and Steel Prices," in *Economica*, November 1956.

export and the import trades were absolutely greater than before the war, although they were less in relation to total production. Direct exports, which consisted almost entirely of finished steel, represented about 15 per cent of the total output (calculated in ingot tons), rising to about 20 per cent in 1957.¹ Imports of pig-iron in this period amounted to 5 per cent of the home production, and imports of steel, which included a wide variety of crude and finished steel, rather less than 10 per cent. The conditions of international competition have recently been affected by the establishment of the European Coal and Steel Community by Germany, France, Belgium, Luxemburg, Holland and Italy. Until 1958, the active world demand for iron and steel prevented any collision with the interests of the British steel producers. In the course of that year, however, a recession occurred, and if trading conditions should deteriorate further, this country would doubtless be obliged to take a more active interest in the pricing and export policies of the Community than she has displayed up to the present.

v

Location

The changes in the location of the iron and steel industry have already been traced up to the great turning-point in British industrial history, the boom of the early seventies. By that time the North-east Coast, after a period of very rapid growth, had become the chief centre of pig-iron production. Its advantages in securing imported ores and in handling exports led to a further expansion during the next forty years. In 1872 it had been responsible for 29 per cent of the British pig-iron output; by 1913 its proportion had increased to 38 per cent. This district then accounted for the larger part of the country's export trade in pig iron, and it also supplied other British centres, notably Scotland, with that product. In Scotland itself the pig-iron output had increased very little; for the local ores were exhausted and the industry depended on extraneous supplies of iron-stone which it smelted with uncoked coal. Yet it still ranked second as a producing area. In South Wales and Staffordshire output had declined because of the exhaustion of local raw materials; and the hematite area of Cumberland and Lancashire was affected, though in a less degree, by the same cause. The West Riding and Derbyshire had doubled

¹ Exclusive of steel embodied in exports of finished manufactures.

their output, and certain new centres had risen to importance through the exploitation of rich, but previously little-worked, ore-fields. These were Oxfordshire, Rutland, Lincolnshire, Leicestershire and Northamptonshire. In 1882 these areas together produced only 16 per cent of the British ore output; by 1913 their combined output was greater than that of the largest British field, Cleveland, and represented 41 per cent of the whole production. Under the conditions of manufacture of the early nineteenth century the pig-iron industry had grown up on the coalfields, and when ore had not been found in close proximity, it had been transported to them. But the fuel economies achieved during the nineteenth century reduced the weight of coke required to smelt a ton of ore. British ores were relatively low in iron content,¹ and as it became possible by 1913 to smelt two tons of ore with one ton of coal,² it now paid to convey the coal to the ore rather than the ore to the coal. This accounts for the rise in Lincolnshire and Northamptonshire of blast-furnaces situated at some distance from supplies of good coking coal. In the new steel industry the leading centres in 1913 were the North-east Coast with an output of two million tons a year, South Wales with 1,800,000 tons, Scotland with 1,400,000 tons and Sheffield with 900,000 tons. Steel was also produced in Lancashire, Cumberland, Lincolnshire and Staffordshire. Staffordshire and Scotland remained the chief centres of the declining wrought-iron trade.

After the First World War there were further changes in the geographical distribution of production. Domestic ore production declined between 1913 and 1937, partly through the fall in the pig-iron output, and partly through the increased use of foreign ores. The chief loss was borne by Cleveland, where the ores had become very expensive to mine; while the output of Cumberland hematite also dropped. Meanwhile the production of the newer centres, especially Lincolnshire and Northamptonshire, greatly increased, and in 1937 these two areas were responsible for three-fifths of the total ore output. During the next two decades these tendencies were strengthened. In 1957, when the production of ore was over 25 per cent greater than in the late thirties,³ the Midland ore-field (i.e. Lincolnshire, Northamptonshire, Leicestershire, Oxfordshire and Rutland) turned out nearly 95 per cent of the total.

¹ The iron content averages 28 per cent in the case of Cleveland ores and 22 per cent in the case of Lincolnshire ores.

² *Survey of Metal Industries*, p. 11. ³ Annual average output, 1937-39.

Changes in the sources of domestic ore were accompanied by changes in the location of the blast-furnaces. Between 1913 and 1937 the proportion of pig iron supplied by the North-east Coast fell from 38 per cent to 28 per cent, while that of the East Midlands (Northamptonshire, Lincolnshire, Derbyshire and Leicestershire) rose from 16 per cent to 35 per cent. Scotland and the rest of the older producing areas, except South Wales, showed a relative as well as an absolute decline. These trends were modified as a result of the steep rise in pig-iron production after the end of the Second World War. It is true that the shares of the North-east Coast and of the North-west Coast continued to fall; but South Wales much increased its proportion and, in consequence of the construction of new blast-furnaces in Lancashire and Cheshire, that area also advanced in importance. The result is that although the East Midlands has consolidated its position as the chief centre of pig-iron production, its share in the middle fifties was slightly smaller than before the war. In interpreting these changes it should be noted that there has been an even greater increase in the use of imported ore than of home ore since the war.

In the manufacture of crude steel, all the producing areas with the exception of the West Midlands advanced after 1913, and until the thirties there were no very striking changes in the geographical distribution of the output. Even in 1937 the four major producing areas were the same as in 1913, although Lincolnshire had much increased its output and a new centre had arisen in Northamptonshire. All the areas except the North-west Coast have shared in the great expansion in steel output since the end of the Second World War, but South Wales has taken the place of the North-east Coast as the chief centre of production. Lincolnshire and Northamptonshire, and Lancashire and Cheshire have become more important, while Scotland and the smaller centres have suffered a further relative decline.

Locational factors are obviously of major importance in any trade which uses large quantities of heavy materials. The iron and steel industry is faced with the problem of assembling, at the point of production, coal and ore (which are not nowadays found in close proximity to one another) together with scrap (which has very diverse sources of origin), and then of distributing its products, themselves expensive to move, among a variety of markets at home and abroad. The choice of sites where costs of production and distribution are at a minimum must depend in each case on the kind of process employed (for example, in the open-hearth process the proportion of scrap in

the furnace charge is much higher than in the Bessemer process), on fuel efficiency (since reductions in the amount of coal required to produce a ton of product lessen the relative advantages of sites near the coalfields) and on the nature of the ores (for instance, if only poor ores are available, a site on the ore-fields may be an essential condition of their exploitation). If, as an alternative to low-grade local ores, the industry can obtain rich ores from overseas, the choice may be between a site on a home ore-field and one on the coast. In such a case the relative delivered prices of the different ores and the relative costs of smelting them will affect, if not necessarily determine, the locational decision. This is not all. Conditions of supply are liable to change. The raw materials come from exhaustible deposits. Freight rates, which are a large constituent in the price of imported ore, fluctuate violently. The price of scrap varies with the amount that is being thrown up by industry and with the demand for it, which in turn depends on the activity of the iron and steel industry throughout the world. At the same time investment in an iron and steel plant is a long-term, specific investment and a locational decision that proves to be mistaken through unforeseen changes in costs cannot easily be corrected. Finally, the choice of sites for development is also affected by the fact that old centres of production possess acquired advantages, such as an experienced labour supply, which may sometimes offset the superiorities of new centres in natural resources.¹

In view of these complications it is not surprising that controversy has arisen over the location of the British industry. Some critics have complained of the conservatism of the industry in this respect. They allege that the industry has been biased in favour of coastal sites and imported ores to the neglect of the East Midlands ore-fields. Such criticisms have not been confined to the period before 1939. They have been directed also at the post-war development plans and they have sought justification in cost comparisons which demonstrate the superior advantages of the inland areas. Yet, as the tables on page 132 indicate, between 1937 and 1956 no striking advance in the relative importance of the inland ore-fields as iron and steel producing centres occurred. Although the industry now looks forward to a considerable expansion in the use of home ores, ore imports are also expected to rise during the next five years, and it does not appear from the plans formulated in the middle fifties that inland sites are

¹ Cf. British Iron and Steel Federation, "The Location of the British Steel Industry" in *Monthly Statistical Bulletin*, November 1950.

likely to increase their share of the industry to any significant extent by 1962.

It is not possible here to examine in any detail the arguments advanced in the course of this controversy. It seems evident that steel production at inland sites has been cheaper than elsewhere in recent years, although the difference may sometimes have been exaggerated by the critics. Furthermore, the arrangements for keeping down the price of scrap have conferred a cost benefit on centres (such as Lancashire and Cheshire) that use large quantities of scrap at the expense of those that use a high proportion of pig-iron in the furnace charge.¹ Nevertheless, it has clearly been very difficult to effect more than marginal changes in location during a period in which the productive capacity of the industry has been fully stretched in meeting demand. In such circumstances a policy of "patching" old plants was probably inevitable. Should the industry encounter a period of difficult trade, locational changes will doubtless occur through the contraction of output and the scrapping of capacity in the higher cost areas.²

PRODUCTION OF PIG-IRON IN UNITED KINGDOM

(in million tons)

1870-4 ³ ...	6.38	1924 ...	7.31	1938 ...	6.76
1875-9 ...	6.38	1925 ...	6.26	1939 ...	7.98
1880-4 ...	8.16	1926 ...	2.46	1945 ...	7.11
1885-9 ...	7.66	1927 ...	7.29	1946 ...	7.76
1890-4 ...	7.29	1928 ...	6.61	1947 ...	7.78
1895-9 ...	8.64	1929 ...	7.59	1948 ...	9.28
1900-4 ...	8.64	1930 ...	6.19	1949 ...	9.50
1905-9 ...	9.70	1931 ...	3.77	1950 ...	9.63
1910-13 ...	9.64	1932 ...	3.57	1951 ...	9.67
1913 ...	10.26	1933 ...	4.14	1952 ...	10.73
1920 ...	8.03	1934 ...	5.97	1953 ...	11.17
1921 ...	2.62	1935 ...	6.42	1954 ...	11.88
1922 ...	4.90	1936 ...	7.72	1955 ...	12.47
1923 ...	7.44	1937 ...	8.49	1956 ...	13.17
				1957 ...	14.28

¹ A cost benefit not entirely offset by the arrangements described on p. 125 *supra*.

² For further discussion of the locational problems, see, D. L. Burn, *Economic History of Steel-Making*, esp. pp. 459-66; "Recent Trends in the History of the Steel Industry" in *Economic History Review*, Vol. XVII, No. 2, 1947; S. J. Langley, "The Location Problem in the British Steel Industry" in *Oxford Economic Papers*, June 1951; Iron and Steel Board, *op. cit.*, pp. 4-5, 49-50.

³ Annual Averages.

(in thousand tons)

Years	Bessemer Steel		Open-hearth Steel		Electric		Total (including others after 1913)
	Acid	Basic	Acid	Basic	Ingots	Castings	
1875-9 ¹		742.0		140.7	—	—	882.7
1880-4		1,401.9		391.0	—	—	1,792.9
1885-9		1,818.2		996.0	—	—	2,814.2
1890-4	1,298.3	339.0		1,505.8	—	—	3,143.1
1895-9	1,277.7	486.0		2,496.2	—	—	4,260.0
1900-4	1,194.7	579.1	2,795.2	482.7 ²	—	—	4,955.1
1905-9	1,200.2	590.3	3,029.7	1,174.7	—	—	5,994.9
1910-13	1,013.8	577.0	3,331.2	1,902.0	—	—	6,824.0
1913 ...	1,048.8	551.9	3,811.4	2,251.8	—	—	7,663.9
1920 ...	586.6	375.5	3,379.7	4,579.6	55.2	33.9	9,067.3
1921 ...	208.7	54.0	1,170.0	2,216.5	10.6	15.9	3,703.4
1922 ...	288.8	196.0	1,709.0	3,625.5	21.3	18.1	5,880.6
1923 ...	386.6	137.3	2,567.5	5,283.6	40.9	23.3	8,481.8
1924 ...	437.3	109.0	2,410.2	5,125.4	41.8	22.7	8,201.2
1925 ...	477.3	28.0	2,015.5	4,750.0	39.7	24.4	7,385.4
1926 ...	174.4	—	1,054.5	2,265.4	38.8	22.0	3,596.1
1927 ...	475.2	—	2,570.5	5,929.4	48.6	25.8	9,097.1
1928 ...	503.1	—	2,218.5	5,669.3	49.9	28.5	8,519.7
1929 ...	559.1	0.1	2,450.6	6,488.2	56.6	30.2	9,636.2
1930 ...	278.9	—	1,805.3	5,099.2	40.4	35.6	7,325.7
1931 ...	129.3	—	1,181.7	3,785.2	27.8	25.5	5,202.6
1932 ...	125.3	—	1,122.8	3,912.0	32.2	23.0	5,261.4
1933 ...	203.1	—	1,551.7	5,140.2	51.4	23.5	7,024.0
1934 ...	239.2	—	1,751.4	6,678.3	65.6	30.8	8,849.7
1935 ...	199.2	223.8	1,857.6	7,361.3	77.4	29.4	9,858.7
1936 ...	238.6	323.6	2,159.2	8,772.3	108.1	44.5	11,784.6
1937 ...	254.6	417.6	2,276.3	9,673.0	154.6	60.8	12,984.0
1938 ...	163.9	430.6	1,720.5	7,743.3	159.5	63.2	10,397.9
1939 ...	232.8	701.6	2,157.1	9,704.8	212.4	79.6	13,221.3
1940 ...	175.6	738.0	2,173.5	9,273.9	309.3	126.1	12,975.3
1941 ...	97.9	695.8	1,807.7	8,944.8	411.5	161.3	12,312.2
1942 ...	95.5	726.4	1,605.0	9,393.9	638.7	221.0	12,941.7
1943 ...	72.1	731.3	1,408.5	9,555.2	726.4	265.6	13,031.2
1944 ...	85.4	708.5	1,172.5	9,096.4	546.7	248.4	12,142.2
1945 ...	170.7	687.0	1,159.1	9,025.7	361.4	180.6	11,824.4
1946 ...	209.8	723.8	1,228.6	9,900.6	345.0	134.3	12,695.3
1947 ...	207.9	678.2	1,228.8	9,896.9	425.7	150.0	12,724.5
1948 ...	218.3	786.2	1,398.3	11,589.3	526.1	180.8	14,876.6
1949 ...	226.4	818.8	1,367.0	12,230.0	543.7	196.0	15,552.9
1950 ...	247.8	845.7	1,310.7	12,981.2	528.8	207.6	16,292.7
1951 ...	241.4	862.1	1,259.4	12,277.4	574.8	244.5	15,638.5
1952 ...	245.9	887.2	1,238.8	12,922.6	630.0	300.2	16,417.9
1953 ...	263.4	797.6	1,132.5	14,297.6	619.3	310.4	17,608.5
1954 ...	264.5	909.4	995.4	15,248.9	621.0	308.4	18,519.7
1955 ...	252.2	1,031.6	1,000.2	16,252.2	737.4	361.0	19,790.6
1956 ...	230.1	1,078.3	985.7	17,017.5	792.5	405.2	20,658.9
1957 ...	250.4	1,058.3	960.7	18,075.2	793.9	417.3	21,699.1

OUTPUT OF PIG-IRON AND FERRO-ALLOYS BY DISTRICT

(Percentages of Total Output)

					1913	1937	1956
South Wales and Monmouth	...	...	...	...	9	10	17
North-east Coast	...	...	...	...	38	28	21
Lincs. and Northants.	...	...	...	...	16	35	33
Scotland	...	...	...	...	13	6	7
North-west Coast	...	...	...	...	11	10	8
Lancs. and Cheshire	...	...	...	}	13	4	8
Others	...	...	...			7	6
TOTAL	...	...	...	...	100	100	100

OUTPUT OF CRUDE STEEL BY DISTRICT

(Percentages of Total Output)

						1937	1956
South Wales and Monmouth	...	...	...	...	...	20	23
North-east Coast	...	...	...	...	...	22	20
Scotland	...	...	...	...	...	15	12
Sheffield	...	...	...	...	...	13	13
Lincs. and Northants.	...	...	...	...	...	13	15
Lancs., Cheshire, Flint	...	...	...	...	...	8	9
Others	...	...	...	...	...	9	8
TOTAL	...	...	...	...	...	100	100

CHAPTER V

ENGINEERING

I

Scope and Character

Engineering is the most modern of all the great industrial groups. Since it is engaged in providing the equipment for mechanical transport and for power-driven productive plants, together with apparatus for lighting, heating and drainage, it could not exist save in a highly developed economic system; and before 1760 there was little place for it. From then down to the present time it has steadily extended its sphere; but even now it has reached a position of major importance only in the more advanced countries. This is because it requires for its setting a diversified industrial system which alone can provide it with the variety of manufactured products and skilled labour necessary to its existence.

Engineering can scarcely be regarded as a single industry. It consists rather of a group of separate trades which differ from one another in age and origin. Reference to a few of them will bring out their diversities. The manufacture of stationary steam-engines may be regarded as having achieved the status of an industry during the last quarter of the eighteenth century, and its expansion followed on the adoption of steam-power by a succession of trades. Textile machinery began to be produced by specialist firms in the first quarter of the nineteenth century. The industries producing locomotives, rolling stock and other railway equipment appeared with the advent of railways in the thirties. The construction of steamships and of marine engines became a large branch of engineering after 1850. The last quarter of the nineteenth century saw the creation of many new branches. The expansion of machine-tool production led to the appearance of several distinct trades, and the adoption of mechanical methods of production by a number of small metal industries which had hitherto been handicrafts brought many of them within the sphere of engineering. The production of gas-engines in substantial quantities began in the seventies. The cycle

trade and electrical engineering became important in the eighties. The motor industry appeared in the later nineties. The aircraft industry grew to importance during and after the First World War. The manufacture of radio equipment began in the early years of the century and developed rapidly during the nineteen-twenties with the establishment of broadcasting stations. Several new branches have been added since 1945.

Some of these branches of engineering have been created by the establishment of new firms for the exploitation of patents. Others have originated either by a gradual process of subdivision from the older sections of the industry, or from within the machine-using trades. Thus, in the early days of the textile industry, each spinner commonly made his own machinery; but later some firms abandoned yarn production altogether to specialize in the manufacture of plant. The construction of gas- and oil-engines and even of machine tools was originally taken up by the manufacturers of steam-engines or by general engineering firms. Then, as demand grew, specialization on particular products gave rise to separate industries. In the same way, the cycle trade originated among rifle-makers and sewing-machine producers, and motor-car manufacture grew out of the cycle, the general and electrical engineering, gas-engine, coach-building and the tinplate-ware industries; while the radio manufacturing industry originated in firms engaged in various branches of electrical apparatus production or in the manufacture of scientific glassware.¹

This continuous process of development and innovation has made the boundaries of the engineering industry difficult to define. On one side, it merges with the iron and steel trade with which its fortunes have from the beginning been closely linked. Indeed, metallurgical discoveries and engineering progress have proceeded together. Without the introduction of steels for high-speed metal-working tools and of alloys which will stand up to exceptional strains when in use, many of the great achievements of the engineers during the last half-century would have been impossible. The motor and aero-engine industries have been particularly dependent on the skill of the metallurgist. Jet propulsion in aircraft, for instance, only became practicable because of improvements in the quality of high-tensile strength alloys which retain their properties at high temperatures. In the heavy branches of engineering, the process of vertical

¹ Cf. G. C. Allen, *The Industrial Development of Birmingham and the Black Country, 1860-1927*, pp. 293 *et seq.*

combination has linked up the manufacture of iron and steel and that of the finished product; while foundry work may be grouped indifferently with either of the two trades. On another side, the limits of engineering become blurred when the various small metal industries, such as the manufacture of small tools and implements, are approached; and in any attempt to define the trade, decision must be arbitrary.

The diversity of engineering extends to its methods of production and distribution, to the markets which are served by its various branches, and to its location. Some sections, for example, are concerned exclusively with the production of equipment for other trades and dispose of their goods direct to the manufacturers who need them; others, like the motor and cycle trades, sell to the general public through various distributing agencies. Some engineers, such as the producers of textile and agricultural machinery, normally look to the overseas market for the bulk of their business. Others, e.g. the motor manufacturers before 1939, find the majority of their customers in Great Britain. The different machinery trades are to be found, as a rule, in the neighbourhood of the industries they serve. Thus, textile engineering is situated in Lancashire and in the West Riding, and marine engineering on the North-east Coast and the Clyde. Other branches, also, are concentrated in particular districts. Motor and cycle manufacture is to be found largely in the Midlands, agricultural engineering in the eastern counties, electrical engineering in Lancashire and the Midlands. Yet, although some of its parts are highly localized, the industry as a whole is scattered and no great centre of population is without some important share in engineering.

In spite of these diversities, there are certain underlying characteristics which give unity to the trade. Most branches are engaged in making capital equipment for further production or for transport. All are concerned with highly composite articles of which the main constituents are metal. All are derivative in the sense that they use, as their materials, the finished or semi-finished products of many different industries. All employ complex machinery and, throughout the trade, there is a similarity in the technical problems involved. In nearly every branch a considerable proportion of the labour consists of skilled male workers. Since the engineers are makers of producers' goods, it is not surprising that practically all sections of their trade are liable to exceptionally great fluctuations in activity. This common sensitiveness to the cyclical movements of trade is

illustrated particularly by shipbuilding, and will be referred to in the chapter devoted to that industry.

The development of engineering is closely bound up with the progress of invention. The introduction of a new method of mechanical production into a trade which was till then a handicraft may create a new branch of engineering, and the discovery of a new mechanical principle may reduce the importance of existing branches. The appearance of the internal-combustion engine and of electrical power brought new industries into being; but this enlargement of engineering was achieved, to some extent, at the expense of steam-engine production. Capacity for rapid adaptation to changes in demand is, therefore, essential for continued success in engineering production. The ready response of producers to these changes is demonstrated by the variations in the scope and nature of the production of such firms as can look back on a long history. For instance, a firm founded about eighty-five years ago for general engineering work took up the manufacture of miners' electrical safety lamps in the first decade of the present century and for some years it specialized on this product. Then it enlarged the scope of its business to include numerous kinds of electrical equipment, while as a survival of its old general engineering trade it continued to produce felting machinery for the hat industry. Another firm which developed during the inter-war period as a producer of motor-cars and aero-engines branched out just before the Second World War into the manufacture of printing machinery. An aircraft company after 1945 found a use for its surplus equipment of high-precision tools in the production of a new type of fountain-pen. Within each section of the industry, moreover, there is a striking contrast in the policy of particular firms. At any moment some firms are found to be specializing on a narrow range of goods within a certain class (for instance, on one or two types of machine tools); others have a diversified output, such as that of the Sheffield firm which undertakes complete mechanization schemes for several kinds of industry.¹

The British engineering industry has long enjoyed a high reputation for the reliability of its products, and many British firms confine themselves to specialities and to goods of distinctive design and high quality. Like the corresponding American industry, however, British engineering has been a pioneer in the introduction of mass-

¹ These examples are taken from S. Marriner, *Changes in the Scope of Production of Industrial Firms* (an unpublished thesis in the library of the University of Liverpool).

production methods and in devising and applying new managerial techniques. The Americans, who introduced the "interchangeability" principle into some branches of engineering about the middle of the nineteenth century, and who applied mass-production methods with great success to the motor and other industries during the present century, set the pace. But British engineering firms followed this lead after the First World War, and they were foremost in working out and adopting standard specifications for components, in association with the British Standards Institution (formerly the British Engineering Standards Association). These new methods have reduced costs by permitting the use of repetition processes and the substitution of semi-skilled for skilled workers on the machines; while the assembly of standardized components has in some branches taken the place of skilled fitting. Mass production has been carried much further in the United States than in this country, partly because of the relatively high price of skilled labour there, and partly because of the large home demand for standardized goods. Great Britain, with a smaller and less uniform home demand, and with the attention of her manufacturers concentrated to a greater extent than the Americans upon the diverse demands of foreign customers, lagged behind in this respect, even in the production of the same class of article. Furthermore, the engineering products on which the two countries have specialized have differed widely. The Americans have tended to concern themselves primarily with goods which lend themselves to mass-production methods, while the British have found that their relative advantages are greatest in goods that require skilled workmanship. The superiority of the Americans in motor-car manufacture and of the British in shipbuilding and marine engineering is an illustration of this contrast.

The extent to which international specialization has been carried in this industry is brought out by the export figures during the inter-war period of the three main producing countries, the United States, Germany and the United Kingdom. In the late twenties, a League of Nations report, based on an examination of those figures, showed that while the United Kingdom was the chief exporter of steam-engines, railway equipment, cycles, motor-cycles, textile machinery, electric cables and heavy electrical machinery, she was overshadowed by her two rivals in most of the newer and lighter products.¹ America

¹ League of Nations, *Memorandum on Production and Trade, 1925 to 1929/30*, p. 67.

held first place in the export of motor-cars and machine tools, and Germany in electric lamps and most kinds of electrical apparatus. Subsequently some important changes occurred, but the same pattern of international specialization could still be perceived in the thirties, as the following table shows:

PROPORTION OF VARIOUS CLASSES OF GOODS IN TOTAL
EXPORTS OF MACHINERY AND VEHICLES IN 1937¹

(as percentage of total value)

<i>Class of Goods</i>	<i>U.K.</i>	<i>U.S.A.</i>	<i>Germany</i>
Electrical Machinery and Apparatus	19	13	22
Machine Tools	2	7	15
Prime Movers and Boilers	7	2	4
Textile and Leather Machinery	6	2	9
Ships, Vehicles and Aircraft	38	49	25
Other kinds	28	27	25
All Machinery and Vehicles ...	100	100	100

II

The Growth in Production and Foreign Trade

The resistance of this industry to precise definition and the frequent changes in the character of its products make accurate description of its progress during the last 75 years difficult. It seems clear, however, that the rapid growth during the 30 years before the First World War of the numbers employed in the whole metallurgical group, which includes ferrous and non-ferrous metal manufacture, was due chiefly to the expansion of engineering. Figures of output are not available for comparison during this period; but foreign trade statistics show that exports of machinery rose steadily from 1880 until the end of the century, increased rapidly after 1900, and were nearly three times as great in value in 1909-13 as in 1880-4.²

¹ Cf. A. J. Brown, *Applied Economics*, p. 190.

² *Survey of Metal Industries*, p. 137. "Machinery" here includes agricultural machinery, boiler-house plant, prime movers, machine-tools, locomotives, sewing-machines and textile and miscellaneous machinery; it excludes electrical and marine engineering products.

Exports probably represented about half the output of the main engineering products in 1907,¹ and in 1913-14 the employment afforded in the United Kingdom by the whole engineering industry, including shipbuilding, was in the neighbourhood of 1½ million.

During the First World War engineering, the vital munitions trade, expanded rapidly. At the end of the post-war boom the numbers engaged were probably 50 per cent greater than in 1913,² and the capacity and labour force of the industry were then far in excess of peace-time needs. With the coming of the depression in 1920 a contraction occurred, and although many workers transferred themselves to other industries, unemployment in engineering remained very heavy. At the same time it became increasingly obvious that important changes had occurred in the relative magnitude of the different branches. According to the Census of Production the output of the general engineering trade in 1924 showed little, if any, increase over that of 1907, and between these two dates the production of certain types of machines, such as steam-engines, locomotives and textile machinery, had fallen. On the other hand, newer manufactures, like the motor and electrical trades, had greatly expanded. During the rest of the inter-war period these changes were carried much further. The index of production for engineering as a whole (including shipbuilding) rose from 100 in 1924 to 121 in 1929. It declined heavily during the World Depression, but by 1934 it had already almost returned to the pre-depression level. From then on, the advance was rapid. Between 1934 and 1937 output rose by about 45 per cent, and by that time it was probably some three-fifths greater than in 1924. Employment had not increased to the same extent because of the rise in productivity; but there were probably 30 per cent more workers in the industry than there had been in 1924.

The Census of Production figures for 1924 and 1935 show wide disparities in the movement of output in the main branches of the trade. The production of the shipbuilding, railway rolling stock and carriage, cart and waggon industries fell, and that of mechanical engineering changed very little, whereas substantial advances occurred in electrical engineering, motors, cycles and aircraft. Indeed the growth in these trades accounted for most of the expansion

¹ *Ibid.*, p. 141. In addition to the classes of goods mentioned in the previous note as being included with "machinery," for the purpose of this computation railway rolling stock (except that produced by railway companies), motor vehicles and cycles, implements and tools, cutlery, and firearms other than those produced in Government factories are included.

² *Ibid.*, p. 133.

in the industry as a whole. Within each of the main branches, moreover, there were important changes in detail. For instance, in mechanical engineering there was a fall in the output of marine engines and textile machinery, but a large increase in that of machinery for food manufacture, machine tools and miscellaneous machines.

The changes in the character of engineering output between the wars were reflected in the export trade. But while the domestic sales of engineering goods as a whole increased, the rise in the foreign sales of the newer branches of the industry was insufficient to offset the decline that occurred in those of the older branches. When in 1928 the Balfour Committee analysed the trade returns, it was able to show that the exports in 1924 of non-electrical machinery (as defined on page 138) were in weight about a third less than those of 1913.¹ There was an improvement in the later twenties, but in 1929 the exports of these types of machinery were well below those of the pre-war period. During the thirties they declined further, chiefly through the steep fall in exports of textile machinery, prime movers and sewing-machines. The losses could be attributed to the successful competition of other countries in products in which international trade as a whole had been stagnant. For instance, during the twenties British exports of agricultural machinery were displaced by American, German and French products, and although Great Britain remained until the World Depression the chief exporter of textile machinery, she lost ground through the advance of the same countries in that trade. In the thirties Germany took the lead in textile machinery mainly because some of the chief importing countries were among those with which she was able to make bilateral bargains favourable to her machinery exports. In locomotives Great Britain's trade diminished through the slowing up of railway development and through the appearance of local industries in former customer-countries. Her exports of prime movers suffered in consequence of the displacement of steam plants, on which she had specialized, by other forms of power generation. In machine tools the world market, even before 1914, had been dominated by the United States and Germany, and it was those countries which obtained most of the large increase in international trade during the inter-war years. In exports of new ships, also, the United Kingdom lost ground partly through the stagnation of international trade and partly through the expansion of shipbuilding abroad.

In the newer types of products the United Kingdom's export trade

¹ *Survey of Metal Industries*, p. 204.

expanded over this period; but her competitors obtained the leading positions in the market. Before 1913 Germany had been the chief exporter of electrical apparatus and machinery, and had been followed by the United Kingdom and the United States in that order. By 1924 the exports of the United Kingdom and the United States had risen and were about equal in value, while Germany's had fallen behind. During the next ten years Germany recovered her former position, and this she retained until the outbreak of the Second World War. In 1937 the total value of electrical machinery and apparatus exported from the three great engineering countries was about £70 million; Germany supplied 37 per cent, the United States 35 per cent and the United Kingdom 28 per cent. The branch of engineering which grew most rapidly between 1914 and 1939 was the motor industry. The United States throughout the period supplied the bulk of the vehicles that entered into international trade, although the United Kingdom led in motor-cycle exports.

On the eve of the Second World War these three countries dominated world trade in engineering products as they had done before the First World War. But the relative positions of the three had altered. In 1913 the United Kingdom and Germany were rivals for first place and, in value, their exports were about equal. The United States was then well behind. In 1937 American exports were nearly twice those of the United Kingdom, whose exports were some 15 per cent less than Germany's. This change had come about only to a slight extent because of the displacement of traditional British exports by those of the other countries. The main cause was to be found in the fall, or very modest growth, in world demand for the class of goods on which Great Britain specialized on the one hand, and her failure to obtain a dominant share in trade in the newer types of goods for which world demand had increased on the other hand. In other words, demand during this time turned away from the products which this country was well fitted to supply to those in which her competitors possessed superior advantages. Thus the experience of the engineering industry in foreign trade epitomized that of British industry as a whole during the inter-war years.

The Second World War disturbed the existing trends both in production and foreign trade. As during the previous war, the industry as a whole grew immensely, although the concentration of its plants on the manufacture of war equipment meant that the output of some kinds of goods had to be reduced. Certain branches of the industry that had been in decline, notably shipbuilding, revived

under the stimulus of war-time demands, while technical innovation called new types of production into being, such as the manufacture of radar equipment and jet-propulsion aircraft. By July 1945 the number of insured persons in employment in Great Britain within the engineering group was 57 per cent greater than in July 1939. The proportion of women in the industry had risen from 13 per cent to 31 per cent of the total employment.

When the war ended there was a contraction; but growth was soon resumed and in June 1948 employment was about a third greater than in 1939. In the immediate post-war years the industry was faced with a major task of reconstruction, for it had to divert its resources from the production of munitions to the manufacture of goods needed by civilian markets at home and abroad. The arrears of maintenance of capital equipment were very considerable, and the heavy investment programme in power stations and in industrial re-equipment, which the government sponsored, made exacting claims on many types of engineering firms. The development in Great Britain of new industries, such as oil refining and synthetic textile manufacture, provided many fresh opportunities for the manufacturers of machinery and plant. In foreign countries also there was an urgent demand for capital goods, and the absence of Germany from world markets for several years threw the task of supplying those goods on Great Britain and the United States. In particular the under-developed countries, such as India, sought to use their accumulated sterling balances in the purchase of equipment for new industries and public utilities. Nor was this activity limited to the manufacturers of producers' goods. Consumers were intent upon replacing their supplies of durable goods, including household machinery and motor-cars, and fresh engineering capacity was required for the manufacture of new products such as television sets. Some of these industries, like those concerned with producers' goods, found large markets overseas; the rise in exports of motor vehicles to the United States was one of the most remarkable features of the post-war British export trade.

The engineering industries were long handicapped by a shortage of steel and of certain types of skilled labour. Nevertheless, they were able to take advantage of the buoyant demand that developed immediately after the war more readily than the trades, such as textiles, that had suffered a war-time contraction. After 1950 the pressure on their resources was increased as a result of the resumption of heavy expenditure on armaments, and several branches of the

group, including aircraft manufacture, entered upon a period of renewed expansion. Throughout the economy the continued scarcity and high price of labour encouraged technical innovation and the resort to labour-saving methods. The mechanization of production was extended and new types of power-driven equipment in transport and agriculture as well as in manufacture were devised. There was a conspicuous advance in the use of the various methods and contrivances popularly described as "automation".¹ All these developments stimulated the demand for engineering products. In spite of the return of Germany to international markets in the early fifties, British engineering production continued to expand, for the investment boom maintained a lively demand for machinery and the flourishing condition of world trade greatly benefited the shipbuilders. Later the industry received a further powerful stimulus from investment in nuclear power stations. It is true that during the fifties there were minor recessions in particular sectors, such as that in the motor industry in 1956; but for this industrial group taken as a whole the post-war years were a time of continuous growth to which it would be difficult to find a parallel in its history.

The result of the sustained expansion may be demonstrated statistically. In 1957 the output of engineering goods, in volume, was probably twice that of the immediate pre-war period. As this was a much larger growth than that in industrial production as a whole (which was about 50 per cent), the importance of engineering in the country's industries was substantially increased. In 1935, they had been responsible for about a quarter of the net output of the manufacturing trades, by the middle fifties the proportion was not far short of two-fifths.² These industries, moreover, had made the

¹ Automation is usually considered to cover the following:

- i. Increased mechanization and, in particular, the addition to existing machines of devices for transferring materials from one machine to another so that a production line becomes entirely automatic.
- ii. The use of devices for the automatic control of production processes so that any divergence from the norm is corrected (such devices are commonly applied in the operation of oil refineries and chemical plants).
- iii. The use of electronic computers which not only save labour otherwise used in calculations, but by storing information and by providing answers to complicated questions at high speed increase the capacity of management to control large-scale industrial operations.

(Department of Scientific and Industrial Research, *Report on Automation*; see, also, S. R. Dennison, "Some Aspects of Automation" in *National Provincial Bank Review*, August 1956.)

² According to the Census of Production, 1954, the engineering and vehicle trades were responsible for 37 per cent of the net output of the manufacturing industries.

major contribution to the expansion of the British export trade over this period. In 1937-8 engineering goods accounted for about 22 per cent of the total exports of United Kingdom produce, in 1955-6 the proportion was about 40 per cent.

The various constituent industries in the group did not all advance at the same rate. An especially marked growth was shown by the trades that produced aircraft, internal-combustion engines, agricultural machinery and tractors, machine tools, mechanical handling equipment, diesel engines and locomotives, electronic equipment and office machinery. Some industries that became of considerable importance had been very small indeed before the war, e.g., the manufacture of typewriters. But other growing industries were old established branches of manufacture which, after a long period of decline, succeeded in regaining their former magnitude, such as shipbuilding and marine engineering. These developments were attended by the expansion of many once small firms and by the incursion of former industrial leaders into new fields. The contributions of each of the several trades to the post-war growth in engineering exports came at different times. In 1953-4 the motor industry was the main contributor to the expansion, in 1954-5 the machinery trades, and in 1955-6 aircraft manufacture and shipbuilding.

It is reasonable to suppose that the tendency for the engineering industries to assume an ever more conspicuous position in the industrial life of the country will continue. Invention and innovation, either by product or process, are likely to maintain the demand for instrumental goods, and efforts to raise productivity throughout British industry cannot succeed unless the supply of power units and machinery of all kinds is constantly renewed and enlarged. In so far as these developments bring about a rise in personal incomes, the engineering industries will be called on to supply increasing quantities of durable consumption goods, such as motor-cars and electrical apparatus. The growing importance of engineering goods in the export trade is in continuance of a long tendency. For many years textiles, formerly the major item among British exports, have been losing ground with the establishment of efficient textile industries in former customer-countries. The production of engineering goods, however, is still largely confined to the advanced industrial nations—in 1956 the United States, Germany and the United Kingdom together produced three-quarters of the machinery that entered into international trade. The industrialization of countries still in an early stage of development is likely, for a long time to come, to have the

effect of increasing their purchases of capital goods from these three producers. The success of the United Kingdom in securing a high proportion of this trade will depend not only on her efficiency as a producer of the goods at present in demand but also on her skill in invention and innovation.

GROSS OUTPUT OF THE ENGINEERING INDUSTRIES¹

	1935		1953	
	<i>Value (£ million)</i>	<i>Per cent of Total</i>	<i>Value (£ million)</i>	<i>Per cent of Total</i>
Shipbuilding and Repairing ...	46	8	297	7
Marine Engineering ...	12	2	92	2
Machine Tools and Handling Equip- ment	17	3	201	5
Other Mechanical Engineering ...	124	23	980	24
Constructional Engineering ...	20	4	125	3
Electrical Engineering (General) ...	56	10	418	10
Radio and Telecommunications ...	40	7	289	7
Other Electrical Goods	29	5	129	3
Aircraft	14	3	336	8
Motor Vehicles and Cycles ...	147	27	938	23
Railway Locomotives and Rolling Stock	42	7	211	5
TOTAL (including Others) ...	549	100	4,135	100

¹ Based on Census of Production figures for the United Kingdom. The types of goods in each category were not precisely identical in the two censuses, but for the purpose of this comparison the error is insignificant.

CHAPTER VI

SHIPBUILDING AND MARINE ENGINEERING

I

The Years of Expansion

Great Britain lost her leadership in one staple industry after another as modern industrialism spread over the world. But there was one great nineteenth-century manufacture in which she retained her predominance until the present time, namely shipbuilding. This was an industry in which her supremacy was not clearly established until after 1850, and it was during the last quarter of the nineteenth century, the period when other staple manufactures first began to be challenged by foreigners, that British shipbuilding achieved its position of unquestioned superiority. The lateness of this development is to be attributed to the fact that the technical revolution in sea transport occurred a generation later than the revolution in land transport. During the first half of the nineteenth century steam-power was being used on Channel packets and on river craft; but largely owing to the uneconomical character of the marine engines and to the consequent difficulty of carrying adequate fuel, steamers were employed only to an insignificant extent in ocean trade. In 1850 only 168,000 net tons out of a total British-owned net tonnage of 3,565,000 were steam-driven, and wood was still the material of which most of the ships were built. Under these circumstances British shipbuilders, although still enjoying the protection afforded by the Navigation Laws¹ and the advantages derived from the growing carrying-trade of their country, had difficulty in competing with foreigners who were able to secure cheaper supplies of timber. In the middle of the century the output of the United States shipyards was about equal to that of the British.

A shift in the geographical distribution of industrial activities is often associated with technical changes, and it was the triumph of the iron and steel steamship over the wooden sailing-ship which

¹ The Navigation Acts were repealed in 1849, and by 1854 the whole of the carrying-trade was open to foreign competition.

gave pre-eminence to the British yards. In 1850 iron manufacture and engineering had reached a far higher stage of development in Great Britain than elsewhere. These trades were conveniently located for supplying shipbuilders, and the country was thus admirably equipped for taking full advantage of the change in methods of construction. America, her principal rival, was still backward in metallurgical development. After the Civil War she turned her attention from maritime commerce to the exploitation of the great natural resources in her interior, leaving Britain with a clear field.

Between 1850 and 1870 iron and steam rapidly overtook wood and sail, in spite of efforts to preserve the older forms of design by the introduction of the fast "clippers" and of the "composite" system of construction. The great increase in the total demand for shipping which was associated with the rapid growth of international trade, particularly of long-distance trade, after the middle of the century, assisted the transition from wood and sail to iron and steam; for a large proportion of the demand during this period was for additional tonnage rather than for replacements. Yet in 1870 British sail tonnage was still four times as great as the steam tonnage, and the aggregate tonnage of sailing-ships built during the preceding twenty years was slightly greater than that of steamships. In the seventies the change was more rapid. The opening of the Suez Canal in 1869 reduced the part taken by sailing-ships in the Eastern carrying-trade. Improvements were effected in boiler and engine design, and steel began to displace iron for ship- and boiler-plate. This last change was of special importance; for, when iron was superseded by steel, a reduction in the weight of the hull and therefore, an increase in carrying power were made possible; while the use of steel for boilers enabled greater pressures to be maintained and so reduced fuel consumption. Lloyd's Register adopted rules for building steel ships in 1877,¹ and during the next decade there was a fall in steel prices. By 1890 the transition from iron to steel was practically completed; and at the same time the annual output of sailing-ships was steadily being reduced as more economical marine engines were devised. In the eighties the trip expansion engine made its appearance, and in the next decade larger and faster steamers with quintuple engines and multiple screws were being built. Early in the present century the steam turbine was adapted to propel fast liners, and continual improvements in the

¹ *Survey of Metal Industries*, p. 364. Comparison in net tonnage.

² *Ibid.*, p. 366.

design of reciprocating engines on the ordinary cargo boats brought a great reduction in coal consumption per horse-power, thus increasing freight capacity. By 1913 the British yards were building steamships almost exclusively, and sailing-ships represented less than one-tenth of the net tonnage on the British Register.

The success of Great Britain in the building of steamships may be attributed to a variety of reasons. Ships are highly composite products, and their successful construction, under competitive conditions, depends in an exceptional degree on technical skill and adventurous management and finance. Great Britain was a country with a diversified industrial life and so could produce the multitude of components and materials required. She had cheap coal and a great share of the world's carrying-trade, which expanded enormously after 1850. Free Trade gave her shipbuilders access to materials at low prices. Finally, the coming of the steamship coincided with a period of British supremacy in metallurgy and engineering, and the technique of these industries came to the aid of a shipbuilding industry of long standing and great experience.

Continental countries and the United States, in spite of their rapid advance in other fields in the last quarter of the nineteenth century, were slow to develop a substantial modern shipbuilding trade, so large were the relative advantages of Great Britain. In 1892-4 this country built no less than four-fifths of the total gross tonnage of merchant vessels launched. During the next decade foreign states made efforts to encourage their own shipbuilding industries by various forms of subsidy and protective measures, and the British proportion declined to 59 per cent in 1900-4. From then until the outbreak of the First World War Britain retained, and even increased, her relative importance, and in 1910-14 she was building 61 per cent of the total tonnage. If ocean-going vessels alone were included, the proportion would be even higher, as the statistics of foreign output cover tonnage built on the Great Lakes of North America. In any case, the relative decline between 1892 and 1914 was of small account, since the annual average of tonnage launched from British yards increased from 998,000 in 1892-4 to 1,660,000 in 1910-14.¹ Thus the years immediately before the First World War were years of great activity, even if we take no account of the large output of warships, which is not included in the figures given. At that time about 22 per cent of the merchant tonnage built in the United Kingdom was for foreign

¹ *Survey of Metal Industries*, p. 369. Since 1907 only vessels of 100 gross tons and over are included in these figures.

owners who obtained from this country more than a quarter of the total tonnage which they required.¹ The importance of ship-building as an exporting industry was even greater than this statement suggests; for large numbers of old vessels were sold abroad every year by British owners. In addition, private yards were actively engaged on warships for foreign account. The industry is believed to have employed in 1914 over 200,000 persons, excluding those engaged in marine engineering and in the Admiralty dockyards.² The labour was almost exclusively male and a large proportion of it consisted of skilled craftsmen.

Note on Tonnage

Three terms are commonly used in the measurement of merchant shipping. *Gross tonnage* represents the total cubic contents of a vessel, calculated at 100 cubic feet to the ton, including all permanent deck structures. Tonnage figures in this chapter are in gross tons except where otherwise stated. *Net tonnage* represents gross tonnage less crew, navigation and engine space. It is the basis adopted for the payment of dues and for all figures of entrances and clearances. *Deadweight tonnage* represents the actual weight of cargo and bunkers a ship can carry without sinking below her marks. It is used in fixing the remuneration of tramps.

Figures of warship launchings are given in *Displacement tonnage*.

II

The Years of Decline

The effects of the war of 1914-18 on the carrying-trade were immediate and obvious. Throughout its duration British mercantile shipping was exposed to hostile attack and suffered losses, through enemy action, amounting to over 8 million gross tons.³ "Its . . . normal functions had always to be performed with an eye to strategic as well as commercial considerations,"⁴ and these conditions interfered with the economical use of the available ships and brought about a shortage for ordinary commercial purposes. Freight rates rose rapidly in 1915, and in the next year the Government introduced a restriction on rates and a system of centralized control which involved a complete subordination of shipping to war-time needs. Demand for new ships was pressing, but a variety of circumstances

¹ *Ibid.*, p. 407.

² Departmental Committee on the Shipping and Shipbuilding Trades, *Report* (Cmd. 9092), 1918, p. 21.

³ *Survey of Metal Industries*, p. 376 note.

⁴ C. E. Fayle, *The War and the Shipping Industry*, p. xii.

prevented the output of merchant vessels from rising in response to it. Many of the yards were actively engaged on Admiralty work, and the shortage of man-power and steel increased the difficulty of rapid production. The inability of the marine engineers to obtain adequate supplies of skilled labour was a particularly serious handicap. In 1916 the output of completed tonnage represented only one-third of the losses due to enemy action and marine perils.¹ Accordingly, in December of that year it was decided to entrust the Controller with full responsibility for mercantile construction, and later this function was transferred to the Admiralty. Attempts were made by the standardization of ships, by the introduction of mechanical devices, by labour "dilution" and by the release of skilled men from military duties, to accelerate the rate of construction. Shipbuilders were urged to extend their plants and the Government itself began to establish new shipyards. In spite of these efforts, however, the launchings of merchant vessels were in 1918 600,000 tons less, and in 1919 300,000 tons less, than in 1913, and the tonnage of the merchant fleet in 1919 was 14 per cent lower than immediately before the war. In the meantime, other countries had greatly extended their output, and the world's production was twice as great in 1918-19 as in 1913-14. This was chiefly due to an enormous expansion of American building.²

When the war was over it was seen that changes had occurred in the relative size of the various merchant fleets. The world's fleet was slightly greater than in 1913, but the British tonnage was less. Indeed, Great Britain's share of the total had fallen from 39 to 33 per cent. The increased maritime importance of the United States was the chief factor in this decline. It is estimated that the capacity of the world's merchant shipbuilding yards doubled during the war, whereas British capacity only increased by about 25 per cent.

In 1919 the industry came under the influence of the post-war boom. Once the restrictions on the movement of goods and persons were partially removed, there arose an urgent demand for shipping space; but although the world's fleet was larger than in pre-war days, it was unable to satisfy all the demands made upon it, for, owing to the war, shipping services had been dislocated and tonnage put to uneconomical use. The British merchant fleet was in a particularly unbalanced condition. The losses during the war had been incurred chiefly among the larger ocean-going vessels; but construction had been concentrated on such types as frozen-meat ships and

¹ *Ibid.*, p. 239.

² *Survey of Metal Industries*, pp. 376-8, 402-8.

tankers. There was a pronounced shortage of fast passenger liners and cargo liners. At the same time, tramp owners found that few of the standardized ships built after 1917 were suitable for their specialized needs.¹ Further, the normal process of replacement had been retarded during the war and many ships were in a bad state of repair. Under these circumstances freight rates increased rapidly. While general wholesale prices rose just over 200 per cent between July 1914 and February 1920, shipping freights rose by 500 per cent.² This raised the price of the existing ships and led owners to place huge orders for new ones. In 1920 the British yards launched over 2 million tons of shipping, which represents a maximum in the history of British shipbuilding, and in March 1921 the tonnage *under construction* reached 3,800,000, which may be compared with a pre-war maximum of 2,600,000 tons. Of the total output of 1920-1 about 40 per cent was on foreign account—a much higher proportion than in the pre-war period.³ The shipbuilders of other countries were also exceptionally busy at this time, and Great Britain, in spite of her own expansion, had a smaller share of the total launchings in 1920-1 than in 1910-13. By the end of 1921 the British merchant fleet had been raised slightly above its pre-war size. The world's fleet was then about 29 per cent greater than before the war.

By this time the effect on shipbuilding of the world trade boom had spent itself, and freight rates, which had begun to decline in February 1920, remained at a low level in relation to general prices in the trade depression of subsequent years. This was to be attributed mainly to the fact that whereas the world's fleet was far greater than before the war, the volume of international trade between 1921 and 1925 was considerably less. The increasing tendency for goods to be carried in large and fast vessels also exercised a depressing influence, since this reduced the amount of shipping required for a given volume of trade. Throughout this period a large proportion of the world's shipping, amounting in 1922 to one-sixth and in 1925 to one-ninth, was laid up in the ports. Consequently, the demand for new ships was small, and the world tonnage of merchant vessels launched between 1922 and 1925 (inclusive) was 21 per cent less than in 1910-13. Warship construction was also reduced. The United States suffered the largest decline and her industry relapsed to a position of small importance. British shipbuilders also were seriously

¹ C. E. Fayle, *op. cit.*, p. 324.

² Cf. J. J. Astor and others, *Is Unemployment Inevitable?*, p. 290.

³ *Survey of Metal Industries*, pp. 382-3, 407.

affected by the depression. The tonnage launched from the yards of the United Kingdom during this period was less than two-thirds of the output of 1910-13 and her share of the world production had fallen from over 60 per cent before the war to 49 per cent in 1922-5.¹ The decline was in some measure due to the large output of Germany who was making efforts to replace the shipping of which she was deprived under the Peace Treaties. In 1926 the British industry received a severe setback as a result of the coal dispute, and the large tonnage launched in the following year is to be accounted for partly by the suspension during 1926 of work on many ships then under construction. Throughout this period of depression most of the ships launched were for replacing old vessels rather than for meeting demands for additional tonnage. The world's replacement demand has been estimated at 72 per cent of the total output in 1925, 92 per cent in 1926 and 82 per cent in 1927.²

After this time the world's shipbuilding industry made a rapid recovery. In 1927-30 the annual average tonnage launched amounted to 2,667,000—an increase on the pre-war period, though still less than the production of 1920-1. This expansion of output was naturally accompanied by a decline in the proportion, though, of course, not in the absolute amount, of the tonnage required for replacement purposes. In 1928 the proportion was 34 per cent, in 1929 60 per cent, and in 1930 47 per cent.³ The main cause of the revival was the recovery of international trade and the consequent decrease in the amount of laid-up shipping, which by June 1927 had fallen to about 6 per cent of the total world tonnage.⁴ At the same time a large demand had arisen for new types of vessel; the oil-burner, the oil-tanker, the electro-turbine-driven vessel and particularly the motor-ship. The rapidity with which this last type came to the front is shown by the fact that whereas in 1924 the tonnage of motor-ships launched amounted to less than one-quarter of the total, in 1930 it was considerably in excess of the steamship tonnage launched. The British industry responded to this world revival in shipbuilding. Its output, however, failed to reach that of 1913, and although the proportion of the world tonnage launched in the United Kingdom rose from 49 per cent in 1922-5 to 53 per

¹ Tonnage built on the American Great Lakes is included in the aggregate.

² League of Nations, *Memorandum on Production and Trade, 1925 to 1929/30*, p. 61.

³ *Ibid.*, pp. 60-1.

⁴ *Survey of Metal Industries*, p. 405.

cent in 1927-30,¹ this country did not fully recover her pre-war position.² The export trade, in spite of an expansion after 1926, remained lower than before the war; and the naval demand also was far less. In 1927-30 the annual average tonnage of warships launched from Government and private yards was only one-quarter of that of 1909-13.³

The failure of the United Kingdom to win back her relative position was due in some degree to the introduction of the new types of vessel which have been referred to. Even before the war experiments had been conducted, especially in Scandinavian countries, with internal-combustion engines for ship-propulsion, and several British companies had been preparing to convert part of their fleets to oil-burning. It was not, however, until the twenties that the new types of ship began to take an important part in the world's carrying-trade. During and just after the war the high cost of bunker coal stimulated the adoption of substitute fuels, and in the same period the diesel engine was shown to be both reliable and economical in carrying-space and in running costs for large and fast liners.⁴ Subsequently the low cost and convenience of oil led to a great increase in the proportion of shipping driven by internal-combustion engines and by oil-fired steam-engines, and the tendency of commerce to require large and speedy ships, for which the internal-combustion engine is particularly suitable, accelerated the transition from the older types of ships. The relatively small space needed for carrying fuel on motor-ships gave them additional advantages over those driven by turbines or reciprocating engines, since this released more space for cargoes. It was not to be expected that the United Kingdom would achieve a position of equal superiority in the construction of these new types as in the old; for her great resources of steam coal rendered a change to ships using other fuels less urgent for her owners than for those of other countries. Further, her marine-engine works were adapted to the construction of steam-engines, and the fact that the basic patents for the diesel engine and the motor-ship were held abroad may have increased the costs of

¹ Sources of statistical data: *Lloyd's Annual Summary of the Mercantile Shipbuilding of the World: Annual Statement of the Navigation and Shipping of the United Kingdom*; and *Statistical Tables Relating to British and Foreign Trade and Industry, 1924-30*, Part II, pp. 118-26.

² In 1929, however, the merchantile tonnage launched was almost equal to the average of 1909-13.

³ *Statistical Tables, etc., 1924-30*, Part II, p. 122.

⁴ C. E. Fayle, *op. cit.*, pp. 375-6.

the British shipbuilding trade in the initial stages of their development. The change effected by the motor-ship in the position of the United Kingdom as a shipbuilding country is indicated by the fact that in 1927-30 she built 65 per cent of the world's tonnage of steamships, but only 41 per cent of the tonnage of motor-ships.¹

Yet the British shipbuilding output throughout this period was far ahead of that of any other country and, in view of the adverse circumstances with which it had to contend, the industry maintained a remarkably high share of the world's production. In spite of both a relative and an absolute decline, it adjusted itself more successfully than most of the other staple trades to the conditions of the post-war decade. Like them, however, though not in the same degree, it was subject to prolonged and serious depression. The additional capacity created during the war was idle after 1921, and the profits earned were small. Throughout the period unemployment never fell much below 20 per cent of the labour force, although the number of insured workers was reduced from 320,000 in July 1924 to 265,000 in July 1930.² Real wages were lower than before 1914 and shipbuilding could no longer be considered a high-wage industry, as it was then.³

Towards the end of 1930 the industry suffered a serious contraction, and as the World Depression became increasingly severe its decline continued. The mercantile tonnage launched fell from just under 1,500,000 in 1930 to 468,000 in 1931 and to only 131,000 in 1933, and at the beginning of 1933 unemployment among the insured workers amounted to 63 per cent. A steep decline in launchings has always accompanied the downward phase of the trade cycle; but in this depression the fall was accentuated by the exceptionally large shrinkage in the volume of international trade, which in 1933 amounted to only two-thirds of that of 1929. Foreign shipbuilding also was very depressed, and the world tonnage launched fell from 2,889,000 in 1930 to 479,000 in 1933. But the decline abroad was somewhat less pronounced than in the United Kingdom, whose proportion diminished from 51 per cent to 27 per cent during this period. British shipping was badly hit owing to the increase in

¹ At the end of 1933 72 per cent of the tonnage under construction in foreign countries consisted of motor-ships; in the United Kingdom the proportion of motor-ships was only 34 per cent.

² Great Britain and Northern Ireland. Figures cover shipbuilding, ship-repairing and marine engineering. They are not comparable with the estimate on p. 149.

³ *Survey of Metal Industries*, p. 391.

Governmental subsidies granted to foreign ships, and the British shipbuilding industry was adversely affected in consequence.¹

As the world climbed out of the depression shipbuilding revived, and the total tonnage launched rose to 2,691,000 in 1937 and to 3,034,000 in 1938. In that year, indeed, launchings exceeded those of 1929 and 1930. The British output, however, did not make a comparable recovery, and in 1937-8 it was only two-thirds that of 1929-30. This meant that the British share remained much lower than in the pre-depression years; in 1936-8 it was only 36 per cent of total world launchings. The export trade, moreover, remained very small throughout the decade, and in 1937-8 the tonnage built for foreign owners was only about one-sixth of that for 1929-30. These figures apply, of course, to merchant ships. In the middle and later thirties rearmament, also, brought new business to the world shipbuilders, and in the United Kingdom the displacement tonnage of warships launched rose steeply.²

The failure of British merchant shipbuilding to regain its pre-depression output at a time when world output was increasing, can be attributed partly to the relative stagnation of British foreign trade, but mainly to the autarchical policies followed by many governments. By various schemes of subsidy and protection, foreign governments succeeded in raising the amount of tonnage launched in their own yards at the expense of the British shipbuilders. So successful were they in doing this that in the middle thirties even British shipowners placed many of their contracts abroad. German competition fostered by currency manipulation and subsidies became very severe, and in 1937 and 1938 the tonnage launched at German yards was nearly twice that of 1929-30. In exports of new ships Germany far surpassed Great Britain during the years just before the Second World War. Japan also went ahead rapidly, and in 1937-8 her proportion of world tonnage launched was about 16 per cent, whereas ten years previously it had amounted to only about 6 per cent.

Government assistance was not, of course, denied to the British shipowners and shipbuilders. Subsidies to tramp shipping were given after 1934, and in 1936 a "scrap and build" plan was introduced. According to this, owners who scrapped three times the amount of tonnage which they built in a given period were granted

¹ See League of Nations, *World Economic Survey 1933/34*, p. 219.

² In 1936-7 the annual average displacement tonnage launched was 98,000, compared with 54,000 in 1934-5 and 25,000 in 1932-3.

subsidies. These schemes certainly stimulated the demands on the British shipbuilders, but Great Britain, as a country that was accustomed to carry the goods of foreign countries and to build ships for foreign owners, was bound to suffer on balance from the adoption of self-regarding policies.

Meanwhile, technical improvement had continued. The efficiency of the diesel engine was much increased, and in 1937-8 44 per cent of the total tonnage launched in British yards consisted of motor-ships compared with only 30 per cent in 1929. This tendency would doubtless have been even more pronounced if it had not been that improvements were also effected in boiler and engine design which reduced the coal consumption per horse-power of ships driven by steam turbines. British shipbuilders and marine engineers were responsible for many of these important innovations.¹ Since ship owners are continually seeking for ships that yield economies in operation, it might have been expected that these technical improvements would have raised sharply the replacement demand for ships during the thirties. In the world as a whole, this indeed took place, and the subsidization of new ships carried it further. But in this industry, as in many others, the official encouragement given to technical improvement was accompanied by official economic policies that were calculated to reduce the opportunities for the efficient use of the resources so created or extended. Never before had official subsidies to shipping and shipbuilding throughout the world been so lavish; never before had the volume of trade which the ships were designed to carry been subject to such drastic and effective restrictions.

III

Recovery After 1939

On the outbreak of the Second World War the British merchant fleet consisted of 6,722 ships of 17,891,000 gross tons; 1,865 ships fewer and a million tons less than in 1914. At the same time the shipbuilding industry had a smaller capacity than at the outbreak of the First World War and the number of skilled workers available was far fewer. Yet the task which the industry had to undertake was even more exacting. In addition to a great naval building pro-

¹ Cf. R. S. Sayers, "The Springs of Technical Progress in Britain, 1919-1939" in the *Economic Journal*, June 1950, p. 277.

gramme and the adaptation of merchant ships to service use, it was faced from the outset with the problem of replacing heavy merchant shipping losses and with an extensive demand for repairs. From the beginning of the war, control over the resources of the industry was assumed by the Government. Merchant shipbuilding was controlled, first by the Ministry of Supply, and then, from early in 1940, by an organization centred in the Admiralty. Whereas in the First World War production in a large part of the industry had been governed by the policy of reaching a high output by means of a standard ship programme, in the last war an effort was made to retain flexibility in organization so that the yards could meet the constantly changing demands for the various types of ships, both naval and merchant. This policy was practicable because the United States could be left to provide production in quantity; and, by applying methods of mass production and the prefabrication of components, the American shipbuilding industry was able to turn out an immense tonnage of standard ships.¹ This division of function between the United States and the United Kingdom was not merely in accord with the strategic situation of the two countries, but also reflected the respective superiorities of their industries. America could harness her vast resources of mass-production capacity in engineering, and her organizing genius for such production, in the building of standard ships; while the United Kingdom used her specialized skill to solve the novel technical problems of shipbuilding which the changing needs of the war threw up. This experience may not be entirely irrelevant to peace-time industrial policy. When two countries have distinctive excellences, it may well be that each should develop its industries on lines which are in accord with its own superiorities rather than that one should play the "sedulous ape" to the other.

It must not be thought, however, that the British shipbuilding industry in war-time could afford to ignore new methods of organization, nor that American methods of prefabrication had no place here. On the contrary, one way in which new resources were called into service was by using those methods. Some of the smaller yards, and also yards which had become derelict during the depression, were employed to build ships from prefabricated units which were themselves produced by numerous engineering firms in different parts of the country. These yards usually concentrated upon the construction of tugs, small tankers, and other small craft, and so left the major

¹ Cf. *The Times, Record of British War Production* (1945), p. 14.

shipbuilders free to use their resources for the larger ships. Much unskilled and semi-skilled labour was employed in this work, and women entered the industry to undertake welding, painting and polishing.

In spite of all the efforts in the shipyards, the end of the war found the British mercantile marine smaller by 4,000,000 tons than it had been in 1939. The shortage of certain types of specialized ships was even greater than this figure suggests. Consequently, after 1945 the industry was busy, as it was after 1918, in replacing the lost tonnage, in reconditioning ships, and in building for foreign owners whose fleets had also been reduced. In the late forties the annual output averaged nearly 1½ million tons of which about a third was for foreign owners. By then the United Kingdom had regained her former pre-dominance in shipbuilding; at the end of 1949 she was responsible for over 45 per cent of the world tonnage under construction.¹ The numbers employed in the industry responded to the recovery in demand. In June 1939 employment stood at about 145,000, apart from about 52,000 in marine engineering. By the end of the war it had risen to 250,000, and although there was a temporary contraction as Admiralty work was reduced, in 1949 it stood at 220,000, with some 80,000 in marine engineering. Thus, between 1939 and 1949 the trends of the two previous decades were reversed, and employment recovered substantially to the level of 1914.

By this time the British mercantile marine had regained its pre-war size, while world tonnage was greater than in 1939. It seemed improbable, therefore, that the high post-war activity in the British yards would long continue. For several years two of the chief competitors, Germany and Japan, were virtually out of production, and it was unlikely that the success of the British shipbuilders in the export markets would survive their return. In fact this pessimism was unjustified. The outbreak of the Korean War in June 1950 led to a steep rise in freight rates and rescued both shipping and shipbuilding from an incipient depression. Owners placed large orders for dry cargo ships and, what was even more important, the demand for oil tankers, already far greater than before the war, was much increased. The boom continued with scarcely a check up to the latter part of 1957 when the steep fall in freight rates and the decline in the rate of increase in the demand for oil suggested that it might be approaching its term. Throughout this period international trade was exceptionally buoyant, rising at a much faster rate than in the

¹ Figures of launchings are from Lloyd's Register of Shipping, *Annual Summaries of the Mercantile Shipbuilding of the World*.

early decades of the century, and the level of freight rates therefore remained high. At the same time, technical improvements in shipping, which will be discussed later, induced owners to replace existing tonnage. But the main cause of the persistent boom in shipbuilding was to be found in the huge demand for oil tankers. Between 1950 and 1956 world demand for oil rose by $7\frac{1}{2}$ per cent annually and, since the length of the average haul from the producing centres to the refineries and markets was increasing, the demand for tanker tonnage rose by $10\frac{1}{2}$ per cent annually.¹ Well over two-fifths of the tonnage launched in British yards during the fifties consisted of this type of vessel.

The output of ships in the world as a whole during these years rose faster than in the United Kingdom, especially after Germany and Japan had resumed their shipbuilding career, and the British proportion of the total tonnage launched fell from over 40 per cent in 1949 to 27 per cent in 1954 and then, chiefly as the result of the remarkable increase in Japan's output, to 21 per cent in 1956. Yet this fall in relative importance was not by any means attributable to a lack of orders but was due simply to the inability of the British yards to expand output and to give deliveries. Throughout this period orders on hand normally represented about four times the annual launchings, and even at the beginning of 1958 they amounted to 6,800,000 gross tons. Failure to raise output to meet this demand—launchings in fact rose only from 1,325,000 tons in 1950 to an annual average of 1,400,000 tons in 1955–7—was a symptom of the mismanagement of the economy as a whole. It was the outcome of the persistent inflation which brought with it a chronic shortage of skilled labour and of materials. In this connection the steel industry's deliberate policy of keeping down steel prices may be questioned since, by stimulating the general demand for steel, it prevented some industries (including shipbuilding) that could have well afforded to pay the equilibrium price from obtaining adequate supplies.² Our export trade in ships suffered particular damage from this policy.³ One may reflect that whereas during the thirties we threw away the benefits of technical advances by underemploying our resources, during the fifties we did the same by the inflationary diversion of resources from their most efficient uses.

¹ *Economist*, January 25th, 1958, p. 339.

² See, p. 125 *supra*.

³ Exports of British ships have lately accounted for about one-third of the British output. But Britain's *share* of the export market declined steeply during the fifties and in 1957 amounted to only 7 per cent (in tonnage); her exports were then exceeded by those of Japan, Germany and Sweden.

IV

Problems of Organization

In shipbuilding, as in many other trades, an alteration of constructional methods was accompanied by a complete change in location. In the days of wooden sailing-ships the Thames was the leading centre of production, although, even then, northern districts were of some importance. With the expansion of iron shipbuilding after 1850, however, the industry moved to the neighbourhood of its new raw-material supplies and located itself on the North-east Coast (the Tyne, Wear and Tees) and on the Clyde. These two districts, which are of about equal importance, were responsible during the inter-war period for approximately four-fifths of the merchant ships built in the United Kingdom. The industry is, therefore, strongly localized. The remaining output is distributed among Belfast, Barrow-in-Furness, Birkenhead, Southampton and a few other centres. In addition, there are ship-repairing yards in all the leading ports.

The location of the industry was mainly determined by the availability of suitable sites for shipyards and by the presence of a local iron and steel trade to supply the chief products required by shipbuilders. But not all the materials are now obtained from the districts in which the shipyards exist. This applies both to semi-manufactured iron and steel and to finished components. Ships' cables and anchors, for instance, have long been supplied by a Midland district, South Staffordshire, where the quality of the local iron is specially suitable for their manufacture. The naval brass foundry trade is centred in Birmingham. For steel, in the form of forgings, plates, sections and castings, the shipbuilders draw part of their supplies from outside districts, and for some of them they were once accustomed to go to foreign suppliers. Before the First World War some 60 per cent of the forgings and about 25 per cent of the steel castings used in the building of merchant ships came from abroad; this was brought about by the "dumping" policy of the German Steel Union.¹ While this reliance upon imports of materials was to the disadvantage of the British steel producers, it strengthened the competitive position of the British shipbuilders by giving them access to supplies at the lowest possible prices.

During the early twenties the industry returned to its pre-war

¹ Departmental Committee on the Shipping and Shipbuilding Trades, *Report* (1918), pp. 24-6.

practice of buying foreign steel, and at one time not only forgings and castings, but even plates, which had previously been supplied almost entirely from British sources, were sold in large quantities and at low prices to the shipbuilders. Towards the end of the decade, however, these imports were reduced through the introduction of measures by the iron and steel industry to restrain competition. Even before 1914 there were arrangements for granting deferred rebates to customers who confined their purchases to the products of the associated steel firms. In 1927 this rebate scheme was re-introduced and extended. At the same time, the consolidation of interests in the iron and steel industry by horizontal amalgamations, and also vertical integration between iron and steel firms and shipbuilders, were carried further, and these, too, helped to reduce the area of competition. With the introduction of protective duties on iron and steel in 1932, and of control over the volume of imports under the arrangements with the European Steel Cartel after 1935, the shipbuilders were compelled to make further reductions in their purchases from foreign sources. Meanwhile, the strengthening of the domestic cartels in the various sections of the iron and steel industry meant that shipbuilders by this time had to buy most of their requirements under conditions in which competition had been largely eliminated. These changes on the side of the supply of materials, together with the long-continued weakness of demand after 1920, led to modifications in the hitherto individualistic character of the shipbuilding industry. These will be described after its general structure has been considered.

Shipbuilding firms vary greatly in size and in scope of production. Some build many different types of ships; others concentrate on particular classes. Some include ship-repairing among their functions; others do not. Some firms build their own marine engines; but many buy them from specialists. An important section of the industry consists of vertically integrated firms that control iron and steel works and engineering shops as well as shipbuilding yards. Even where there is no financial integration, the conclusion of long-term contracts between particular iron and steel firms and particular shipbuilders for the supply of the major steel products has forged close links between the firms that are parties to them. In some shipbuilding yards a controlling interest is held by shipowners. The structure of the industry is thus marked by great diversity.

Marketing conditions differ widely from those commonly found in the factory industries. Sale is usually effected by means of tenders

which arise out of invitations made by shipowners. In times of depression, however, builders sometimes canvass prospective buyers. On the other hand, when demand is very urgent, orders are sometimes given on a "time and lime" basis, that is to say, tenders at fixed prices may be abandoned in favour of contracts by which the shipowner agrees to purchase at realized cost plus a profit percentage. This practice is, of course, frequently resorted to in other constructional industries during periods in which costs are rising. The shipbuilder commonly gives long credits which vary from one to five years, and he is himself financed by the banks during the period of credit. In contracts for the larger liners, it is usually stipulated that the purchaser should make payments to the builder on the completion of the various stages of construction. The great liner companies themselves rely on the money market in order to meet these claims, and in the past the possibility of obtaining credit at low rates was a contributory cause of Great Britain's success in this industry.

Shipowners, like other proprietors of instrumental goods, try to build up reserves and amortization funds so that they can replace their ships as these become obsolete, but throughout the post-war period this policy, despite the high earnings from freights, has been frustrated by heavy taxation and the steeply rising costs of building. At the end of the war, the total liquid resources available from war insurance and accumulated depreciation funds for replacing losses from enemy action were estimated at £493 million, whereas the cost of replacement was put at £600 million.¹ Since then the continuing rise in the cost of construction² has meant that depreciation funds in respect of older ships have been insufficient to pay for their replacement and the high profits-taxation has made it difficult for firms to accumulate sufficient liquid reserves. In 1953 the Chancellor of the Exchequer recognized the immediate seriousness of the problem for industry as a whole by granting an initial investment allowance to be set against tax. When this allowance was abolished a few years later an exception was made for ship construction, and in 1957 the allowance was doubled. Shipowners were also provided with a new source of finance by the establishment in 1951 of the Ship Mortgage Finance Company, capitalized by insurance companies, banks, the Industrial and Commercial Finance Corporation and shipbuilders.³ This

¹ M. G. Kendall, *Economica*, Vol. XV, 1948, pp. 292-3.

² In 1945 the index of building costs stood at 169 (1938=100), in 1951 at 284 and in 1955 at 425. (Cf. L. Jones, *Shipbuilding in Britain*, p. 216.)

³ L. Jones, *op. cit.*, pp. 229-30.

company raises additional resources by debenture issues, and it makes long-term loans on the mortgage of ships built in United Kingdom yards for both British and foreign owners. So far it has made only a modest contribution to the financial needs of the shipping industry, and meanwhile the proportion of world shipping operated under "flags of convenience" (so as to escape the tax burden) has rapidly increased.

Like other industries engaged in producing durable instrumental goods, the shipbuilding industry throughout its history has been subject to wide fluctuations in activity. The extent of these fluctuations may be judged by the degree to which the output of particular years diverges from the quinquennial average.¹

The fluctuations are naturally associated with movements in freight rates. When during a period of booming international trade rates rise, shipowners place new contracts for ships; but as soon as the peak in rates has been passed and a downward trend sets in, the orders fall off very steeply. As the period of ship construction is long, however, the response of output to these changes in demand cannot be immediate. Both 1921 and 1930, years in which international trade, freight rates and new orders declined, were years of high activity as measured by the tonnage launched; for the shipbuilders were then engaged in dealing with orders placed during the preceding boom. Thus, a large number of new ships becomes available just when the demand for shipping space is ebbing fast, and this intensifies the depression in freight rates and increases the reluctance of shipowners to place new orders.

Shipbuilders cannot meet these conditions by making for stock, since the cost of laying up a ship is very high. At the same time they have technical staffs whom they do not wish to disperse and heavy standing charges to which they must make some contribution. Consequently, very keen competition for the diminished number of orders results and very low prices are quoted. At such times costs may be raised by attempts to build types of ships of which the builder has little experience, and the economies that previously may have attended specialization are likely to be lost. When trade improves and freight rates rise, the upward movement is likely to be exaggerated because of the shortage of shipping brought about by years of low output and because the yards cannot build new ships quickly. So there is a rush of orders. The social consequences of these fluctuations are serious. Employment is unstable even in

¹ See, table on p. 164.

periods when the industry is undergoing a secular growth, and as the fluctuations communicate themselves to the industries which serve shipbuilding, the aggregate social costs of this instability are high. In the two worst years of the World Depression for this industry (1932 and 1933), about 60 per cent of the insured workers in shipbuilding were, on an average, unemployed.

TONNAGE OF MERCANTILE VESSELS LAUNCHED,
1895-1957¹

(in thousand gross tons)

<i>Years</i>	<i>Average Annual Output</i>	<i>Highest Annual Output</i>	<i>Lowest Annual Output</i>
1895-9 ...	1,170	1,417	951
1900-4 ...	1,358	1,525	1,191
1905-9 ...	1,396	1,828	930
1910-14 ...	1,660	1,932	1,143
1900-14 ...	1,471	1,932 (1913)	930 (1908)
1920-4 ...	1,342	2,056 (1920)	646 (1923)
1925-30 ² ...	1,352	1,522 (1929)	1,085 (1925)
1931-5 ...	356	502 (1931)	133 (1933)
1936-8 ...	736	1,030 (1938)	856 (1936)
1946-50 ...	1,216	1,325 (1950)	1,121 (1946)
1951-5 ...	1,369	1,474 (1955)	1,303 (1952)
1956-7 ...	1,398	1,414 (1957)	1,383 (1956)

Some industries are able to meet both a secular decline in demand and also cyclical fluctuations by altering their scope of production. Such a solution is hardly available for this industry, since its equipment and much of its skilled labour are specific to shipbuilding. It is true that during the thirties some shipbuilders began to undertake structural steel work, but most of them found no alternative means of occupying their idle plants and workers. The chronic depression in the industry during the inter-war years affected the policy both of the shipbuilding industry and of the government, and in the end led to noteworthy changes in structure.

Government intervention has a long history in this industry. For many years shipbuilders have been affected by the regulations both of the State and of the Classification Societies. Of these the Balfour Committee stated:³

¹ Great Britain and Northern Ireland.

² Excluding 1926.

³ *Survey of Metal Industries*, p. 381.

"Successive Merchant Shipping Acts have been directed mainly to ensure as far as possible the safety of life and property afloat. Under these Acts the Board of Trade are the main authority and control the assigning of load-lines; and Lloyd's Register and two similar bodies, the British Corporation Register of Shipping and Aircraft and the British Committee of the Bureau Veritas, are empowered to assign load-lines on behalf of the Board of Trade; but these classification societies exercise a still more important influence on design and equipment by means of the standards they require for a high classification ensuring cheap and ready insurance. These standards have gone beyond official requirements in some respects; in 1914 nearly half the mercantile tonnage of the world held a classification from Lloyd's Register and nearly all British ships had been classed either by Lloyd's Register or by the British Corporation, and were thus built and maintained in accordance with regulations embodying the latest developments of ship construction."

The regulations, and the co-operation between shipowners and shipbuilders for the purpose of carrying them out, tended to standardize design; but this, far from restricting competition, had rather the effect of rendering it more perfect. They had, however, little relevance to the major problem of mitigating the effects on the industry of instability of demand, and of course did not touch the problem with which it was faced during the inter-war years. Even before this problem had arisen, however, official attention had been given to questions of organization. The Board of Trade Committee on Shipping and Shipbuilding in 1918 declared:¹ "... whilst individualism has been of inestimable advantage in the past, there is reason to fear that individualism by itself may fail to meet the competition of the future in shipbuilding and marine engineering." It suggested that there should be an interchange of experience among shipbuilders, and that employers should take financial guarantees from one another so that it would be unprofitable to them to break wage agreements during a trade depression. Further, it argued that it would be advantageous if the shipbuilding industry could act as a whole in its relations with associated bodies of steelmakers and other suppliers. The Committee also suggested that arrangements should be made among producers "which would lead to the filling up of the hollows and the flattening of the peaks in the curve of tonnage," and a co-

¹ *Report*, p. 34.

ordination of shipowners' demands and shipbuilding capacity was proposed. Little was done, however, during the early and middle twenties to bring about the closer organization which the Committee thought desirable, and it was not until the later years of that decade, when organization among the suppliers became stronger, that a movement occurred in the direction recommended. From that time onwards the changes were far-reaching.

In 1930 the Shipbuilding Conference, a body representative of the whole industry, formed the National Shipbuilders' Security Limited with the object of mitigating the severity of competition by removing excessive capacity. The Company obtained finance by the issue of debentures on the guarantee of participating firms, and it used its funds to purchase and scrap redundant or obsolete yards. During the thirties, yards with a combined annual capacity of over 1½ million tons (about one-third of the total) were dismantled at a cost of £1,750,000. This ambitious "rationalization" scheme, like others of the same type, had the disadvantage of imposing on the operating yards the burden of providing compensation for the closers. In practice, this meant a reduction in the value of the ordinary shareholders' interest in the surviving concerns; but it was expected that this would be counterbalanced both by the economies of working yards nearer to their capacity and also by the higher prices that would follow the decrease in the area of competition. The Shipbuilding Conference at this time was encouraging its members to aim at both these results. It tried to persuade them to specialize, partly because specialization was expected to bring greater productive efficiency, and partly because the practice of tendering for a wide range of types meant the maintenance of an expensive drawing-office staff. At the same time agreements were actually reached about minimum tender prices for certain types of ships, although it is doubtful if these were always observed, and a "fighting fund" was established to help tenderers in their struggle with foreign competitors.

The rationalization scheme was calculated to assist both these lines of policy. The public interest, however, is likely to be promoted only if such schemes reduce costs, and the claim that they do this deserves examination. Empirical evidence is hard to come by. In the early days of the scheme the chairman of the largest company declared that, in consequence of rationalization, his concern would be able to build more cheaply than before when trade revived.¹ Whether

¹ T. E. Elias (Ed.), *British Commerce and Industry*, Vol. I, p. 80.

this result was in fact achieved is doubtful. Demand was so small during most of the thirties that, even after the removal of yards by the National Shipbuilders' Security Limited, the industry was still working far below capacity. We must therefore rely on theoretical analysis to suggest the conditions that must be satisfied if this favourable result is to follow rationalization. It is argued that if the cost of turning out additional increments of output is falling (i.e. if marginal prime costs are falling) in the surviving firms, then the further concentration of output will probably lead them to reduce prices. But if before the rationalization scheme was introduced the firms were perfectly competitive, the marginal prime costs of the individual firms could not be falling, since, if they were, the concentration of output and the elimination of competitors would be taking place without such a scheme. Actually, of course, through the existence of good-will, firms are never perfectly competitive, and rationalization by enforcing concentration of output may lead to economies which enable prices to be reduced. The elimination of good-will, moreover, is likely to increase the elasticity of demand for the products of each of the survivors, since the former customers of the firms that have been closed by rationalization are now likely to be influenced solely by price considerations in placing their orders. In this case, even if marginal costs are not falling, it may pay the survivors to reduce prices.¹ But these considerations apply only to a limited extent to the shipbuilding industry. Ships are built to the detailed orders of expert customers and are supplied on competitive tender, so that the market before rationalization was already more perfect than for most industrial products. It seems, indeed, that the view of most of the builders themselves was that rationalization was valuable because it provided for the elimination of "cut-throat competition" and so led to a rise in prices. In these circumstances, the scheme could scarcely improve the international position of British shipbuilding, although it might be a financial advantage to the producers themselves. When war came, with its huge demand on shipbuilding resources, the destruction of capacity, from being a policy of doubtful expediency came to be regarded as egregious folly.

In the later thirties the shipbuilding industry took another step along the path that led from competition to monopoly. In 1937, largely under British influence, the International Shipbuilding Conference was established. This was in effect an international cartel, the members of which consisted of the shipbuilders of the United

¹ Joan Robinson, *The Economics of Imperfect Competition*, pp. 73-5.

Kingdom, Norway, Sweden, Denmark, Germany, Holland and Belgium. An agreement provided for consultation on invitations to tender and for collaboration in tendering in cases where international competition would otherwise have been involved. Levies were raised from those who were enabled by the collaboration to obtain the order, and the funds were used to cover the costs of operating the cartel and to compensate firms which refrained from competing. It is doubtful if this restriction was very effective. The British shipbuilders had most to gain by the arrangements, but their share of the trade fell off during 1938. It is, of course, possible that the decline might have been steeper in the absence of the cartel; but the bargaining strength of the British shipbuilders was weak because they came to the negotiations as a body of firms that were seeking to defend their position as major suppliers at a time when their costs were higher than those of their competitors. The cartels certainly did not prevent some British shipowners from placing contracts on the Continent at this time, and it appears that after 1938 the agreements lapsed. The chief interest in the cartel lies not in the question of its efficacy, but rather in that it should have been initiated at all by British shipbuilders who had so long operated under highly competitive conditions.

We have seen that after the Second World War the industry enjoyed a period of sustained demand for its products without parallel in its history. But it would be unreasonable to conclude that it has permanently escaped from liability to violent fluctuation. Activity in shipbuilding is primarily a function of international trade which is neither amenable to national regulation nor susceptible to prediction. So, however firmly committed a government may be to a "full employment" policy, it is difficult to see how fluctuations that arise from changes in international trade can be smoothed out. During recent years the tramp owners, whose earnings are especially liable to oscillations, proposed to stabilize tonnage in operation by providing co-operatively for the financing of laid-up ships in periods of declining freight rates. A company called the Tonnage Stabilization Association Limited was formed for this purpose.¹ Such a scheme, if successful, by maintaining greater financial stability in this branch of the industry might assist in providing a more even flow of work to the shipyards. It may be doubted, however, whether sufficient resources could be accumulated to meet the violent fluctuations to which the market for tramp services is exposed, even if general

¹ L. Jones, *op. cit.*, p. 232.

agreement to the scheme could be obtained, especially as this branch of the industry is apparently suffering from a secular decline. Another suggestion is that naval building should be planned so as to compensate for variations in the demand for merchant ships. The timing of naval orders, however, is inevitably determined by strategic rather than by economic factors, and in any case such orders are not likely to play more than a minor role in the future of the shipbuilding industry. In the end it appears as if fluctuations must be accepted as a necessary concomitant of this type of industry, for even if governments were prepared to overlook the obvious general economic objections to subsidies and to "scrap and build" schemes, these would have to be on a most lavish scale if they were to offset the effects of a serious depression.

Cyclical depressions, moreover, are not the only source of fluctuation. One must consider also the nature of the product itself. The normal life of a ship is about twenty years. From this it follows that the normal replacement demand is only 5 per cent of the existing fleet. If for a few years, through a rapid increase in international trade, the demand for additional as distinct from replacement tonnage expands, new shipbuilding capacity will be created to cope with it. If demand for shipping-space then becomes steady at the new level, much of that additional capacity will become unemployed, since subsequent output will be limited to that needed to satisfy replacement demand. Of course, the rate of obsolescence, and so the replacement demand, may be increased through the introduction of new types of ships; for example, the recovery of shipbuilding in the later twenties was assisted by the appearance of the motor-ship and the oil tanker, and by many technical advances in ship construction. Yet once the world's fleets have reached the stage at which they are predominantly composed of these new types, this favourable influence on demand will cease until further invention has introduced another period of rapid obsolescence. This inherent instability is a feature of all constructional trades which can only be maintained in equilibrium if world trade, investment and invention make steady rather than spasmodic progress—a condition which it is difficult to satisfy.

If these obstacles to the achievement of stability are encountered in periods of normal economic development, how much more formidable do they become when war brings its disturbances. The First World War, as we have seen, raised the capacity of the shipbuilding industry, and the high rate of building during the first years of peace

was at the expense of subsequent activity, because of the abnormal age-distribution of the merchant fleets. Experience after the Second World War, though different in many ways, has not been inconsistent with this general analysis. The rapid reconstruction of the world's merchant fleets immediately after 1945 had the result that in the early and middle fifties a high proportion of the ships were new. One might have expected that this would reduce the demand on the shipyards, at any rate for replacement tonnage. But the long sustained buoyancy of international trade, the large purchases of American coal by European countries and, above all, the enormous increase in the demand for tankers preserved a high rate of activity. Further, improvements in ship construction and in marine engines gave shipowners a powerful inducement to replace their older tonnage more rapidly than would otherwise have been expedient. So, even in 1958, when international trade prospects seemed less favourable than at any time since 1945, when freight rates had fallen steeply, and when many ships, especially tramps, were laid up, the shipyards continued to be well occupied on orders placed before the depression began.

The future must clearly depend, for shipbuilding as a whole, on the course of international trade and on technical innovation. It is probable that the secular upward trend in oil shipments, which has played the outstanding part in shipbuilding activity during the last decade, will continue for a long period. Oil companies are likely to seek for economies in the carriage of their products by employing super-tankers of 30,000 dead weight tons and upwards. Further, it is believed that very important technical advances are in sight, such as the use of light alloys and the introduction of marine gas turbines and even nuclear power units. If these advances yield large savings in running costs, owners will be inclined to put forward the replacement of their existing vessels. On the other hand, faster ships and improved devices for handling cargoes, which give a quicker turn-round in the ports, mean that a given quantity of trade requires a smaller volume of carrying capacity.

These conditions affect the shipbuilding industries of all countries in greater or less degree, but it is with their impact on British shipbuilding that we are mainly concerned. So far the large unsatisfied demand for ships has obscured the competitive capacities of the various national industries, and it is not easy to predict how the British industry would acquit itself in a struggle for orders. Up to the present it has been favoured by cheap steel (and steel accounts for

about 20 per cent of the cost of building),¹ and its costs as a whole have compared favourably with those of the chief competitor nations. Like them it has been active in reorganizing its yards and in adopting new production methods, such as the prefabrication of units and the use of welding instead of riveting, methods which save steel and reduce the number of berths required for a given output.² It has been foremost in introducing improvements in steam turbines. Some branches of the industry without doubt have brighter prospects than others. For instance, it is probable that the larger yards that are capable of building super-tankers and great cargo liners can look forward with reasonable confidence, while the smaller and medium sized yards, which occupy themselves in building tramp steamers and small vessels, are likely to be exposed to very keen competition, as they were in the inter-war years. On the other hand, it must be remembered that whereas nearly all the liners now in service have been built since the war, much of the British tramp tonnage is old and will soon have to be replaced. Whether this will provide sufficient work for the smaller yards depends *inter alia* on the type of ships with which this obsolete tonnage is replaced.

In any estimate of the competitive strength of British shipbuilding account must be taken of the conditions of labour supply. In this industry progress in industrial relations has not kept pace with that in technique. The craft organization of the workers still persists in spite of the revolution in methods. Demarcation problems and disputes add considerably to costs. The reluctance of the trade to permit an expansion in the recruitment of apprentices in certain occupations has restricted the capacity of the industry to meet the heavy demand for its products. How far management must bear a share of responsibility for failure to solve these problems is a matter of debate. What is significant is that competitive industries abroad have not been equally handicapped by these labour troubles. Finally, it must be emphasized that comparative costs are not always the decisive factor in the placing of orders. Just as flag discrimination is widely practised in the world's shipping industry, so the shipbuilders find themselves faced with state-subsidized competition in many of their overseas markets..

¹ But, as a qualification, see p. 159 *supra*.

² Welding has the additional advantages of producing a hull which offers less water-resistance than a riveted hull and of making possible the prefabrication, under factory conditions, of large sections of a ship away from the berth. It is regarded as a fundamental technical change.

CHAPTER VII

MOTOR VEHICLES

I

Early History

No modern manufacture has had a more profound influence on the social and economic life of the twentieth century than the motor industry. Its development was accompanied by a great change in the direction of national expenditure, and this resulted in the decay of once-important trades and the rise of a multitude of others which were of small account fifty years ago. It was a powerful factor in producing the migration of industrial activities from the north of England to the south and Midlands during the inter-war period. It profoundly altered technique and organization throughout the engineering trades.

The rise of the motor industry depended on the perfecting of the internal-combustion engine, and a comparison may be drawn between the historical development of the steam-engine and that of this new type of power producer. The steam-engine was designed, first of all, for pumping purposes. It was later applied to the driving of machinery in manufacturing establishments, and finally, when adapted to the locomotive and steamship, it became the main propulsive power in the transport systems of the world. Great Britain had been well equipped to take the lead in the manufacture and utilization of the steam-engine. Her ample resources of steam coal provided at low cost the fuel required; the abundance of raw materials made it possible for her to develop a great iron industry on which engineers depended; the presence of this industry and of great coalfields in the neighbourhood of the coast promoted the growth of a shipbuilding and shipping trade; and the existence of a dense population fostered the development of a railway system. Britain still remains the chief producing country for the heavy machinery and the material associated with the steam-engine. But the rise of the internal-combustion engine and the motor-car reduced the importance of the steam-engine and its associated products and,

so, many of the advantages which this country enjoyed in their manufacture and use.

The first internal-combustion engine took the form of a gas-engine invented by Lenoir in 1860. This was afterwards improved by Otto, Schmidt and de Rochas, and during the later seventies it began to come into common use. The fuel employed was either coal-gas or producer-gas, and the engine effected something of a revolution in manufacturing methods in many trades. Up to this time the small manufacturer had been obliged to dispense with power machinery, unless he could rent it, for the steam-engine was too costly and troublesome for his purposes. The gas-engine, however, was admirably suited to small establishments when gas was available from a local supply. The adoption of mechanical methods of production during the eighties by many of the small metal trades in which handicraft methods had previously prevailed may be attributed partly to the introduction of this new prime mover.¹ The second stage in the evolution of the motor-car was the application of the gas engine to the propulsion of a road vehicle. Long before this several types of steam-engine had been built for use on the roads; but the coming of the railways, together with the Red Flag Regulations of 1831 and later years, put a stop to this development. Just as the early engineers had tried to adapt the steam-engine to locomotive purposes, so the inventors of the first gas-engines pursued the same aim. In 1863 Lenoir himself produced a road vehicle which was driven by coal-gas ignited by an electric spark. In this vehicle, however, the problem of fuel supply presented great difficulties. It was ultimately solved by resort to a fuel of a very different type. Just after the middle of the nineteenth century extensive oil-fields had been discovered in the United States. This discovery was followed by improvements in distillation processes which made available large quantities of gasoline or petrol, a fuel having great energy per unit of weight. Markus in Austria made use of this fuel for his vehicle invented in 1865. Another advance was made when Otto, in 1876, introduced his engine in which the gas was compressed before ignition, with the result that propulsive power was greatly increased.² Benz applied the petrol engine to vehicles in 1878; in 1883 Daimler brought out a high-speed engine for vehicles and boats, and Levasseur devised an improved chassis. Shortly afterwards the manufacture

¹ G. C. Allen, *The Industrial Development of Birmingham and the Black Country, 1860-1927*, pp. 229-30, 314.

² This was the famous four-cycle engine.

of motor-cars was begun under Daimler's direction in Germany. In 1889 Panhard and Levasseur acquired the manufacturing rights over the Daimler engine and began to produce vehicles in France.

In England several types of car were produced experimentally during the eighties and early nineties, according to the designs of Continental models, and in 1896 the English Daimler Motor Company was founded. During the previous year an original design had been worked out by an English engineer who was thus responsible for the first full-sized British petrol motor, the Lanchester.¹ In the meantime another important problem had been solved by the invention of the pneumatic tyre. The pneumatic principle had been discovered as early as 1845; but at that time there was no demand to warrant its application. In 1888, however, when Dunlop took out his patent, the time was ripe for the invention, for cycling was just becoming an important means of transport. Shortly after this the Clincher patent made it possible for the pneumatic principle to be applied to motor-vehicle tyres. Towards the close of the century important advances were made in metal working. As long as internal-combustion engines had been stationary in character they had been heavily built according to the principles of steam-engine construction, since reliability and longevity were the main ends in view. "In these circumstances there was no need to employ anything but ordinary mild steel in the manufacture of forgings."² With the advent of the motor-car, however, the manufacturer was faced with the necessity of producing an engine light in weight in proportion to its power, and he had, therefore, "to seek from the steel-maker material which would possess the necessary strength to permit of the cross-sections' being greatly reduced. Arising from this need an unprecedented demand sprang up for alloy steels," and there was incorporated in shop practice those "complicated processes of heat-treatment . . . without which the advantages of the finer steels would be missed."³ At the same time the great advance of electrical engineering after the eighties enabled efficient apparatus for ignition to be provided. Other detailed improvements occurred in spring-

¹ For more detailed accounts of the development of the internal-combustion engine and of the motor vehicle, see H. O. Duncan, *The World on Wheels*; A. P. Usher, *The History of Mechanical Invention*, pp. 370-2; A. P. M. Fleming and H. J. Brocklehurst, *A History of Engineering*, Chap. IX.

² H. Kerr Thomas, "The Effect of the Automobile Industry on the Midlands" in the *Proceedings of the Institution of Mechanical Engineers*, 1927 No. 3, p. 623.

³ *Ibid.*, pp. 623-4.

suspension, chassis design and lubricants. Thus the motor-car was dependent on the conjunction of a variety of discoveries and improvements in several trades.

Just as England had possessed in the early nineteenth century the advantages which enabled her to achieve supremacy in the manufacture and use of steam-engines, so the United States had the most favourable conditions for the development of the motor-car industry. On the demand side there was America's high income per head; while the huge area of that continent, which was still badly served by railways, raised the importance of all means of transport. The United States possessed productive resources well adapted to the promotion of this industry. Early in its career the American engineering trade had developed a technique of manufacture which was in marked contrast with that prevailing in Europe. This technique was based on what was known as the "interchangeable" principle, according to which machines were produced in quantity to standardized designs and were built up of rigidly standardized parts. As early as 1853, when the British Government decided to adopt the "interchangeable" method of rifle production instead of having each weapon produced by a series of handicraftsmen, it had to import much of the necessary machinery for its rifle factory from America.¹ The wide extension of this principle throughout the American engineering industry had given rise to a great number of independent specialist producers, each of whom contributed a few standardized parts to the finished composite product. The motor industry, requiring as it did a multitude of finished and semi-finished components, was well suited to this system of production. As soon as the manufacture of cars began, therefore, there was available in the United States a great body of producers who could easily adapt themselves to the production of the necessary components. This proved of some advantage in promoting rapid development. Great industrial concerns with an established trade are often reluctant to take up the large-scale manufacture of a new product; while it is difficult for promoters to raise from the public a large capital for a new and untried enterprise. The organization of the American engineering industry, however, permitted the adoption of mass-production methods, yet at the same time, because of the existence of the numerous independent components makers, it spread the risk of loss. The motor manufacturers themselves were able to produce on a large

¹ Cf. G. C. Allen, *The Industrial Development of Birmingham and the Black Country*, p. 187.

scale without amassing huge resources. The parts makers, who manufactured components for several industries, were protected by the fact that their fortunes were not entirely bound up with those of a particular industry. Thus the existing organization and technique of the American engineering trade fitted the country for this new manufacture.¹

In England the "interchangeable" principle had been applied only to minor branches of engineering, and the peculiar advantages of America were lacking. The larger engineering firms were concerned mainly with heavy equipment and were, as in America, sceptical of the success of the new vehicle. Yet, even in this country, the early history of the motor industry shows the working, though in a modified form, of the forces which moulded the great American manufacture, and the industry became concentrated in the district where American conditions found their closest parallel. For reasons which need not here be considered, Coventry during the seventies became the centre of cycle manufacture, and during the great expansion of that industry in the course of the next two decades, Birmingham and Wolverhampton secured a share of it. The highly seasonal character of the demand for cycles, together with the severe depression in the industry during the later nineties, provided an inducement to firms to broaden the basis of their production. The coming of the motor-car gave them their opportunity. The first companies working on Continental patents were established in Coventry for the specific purpose of motor manufacture on the repeal of the Red Flag Regulations in 1896; but many later recruits to the trade consisted of firms already engaged in cycle manufacture. By 1914 there were several large concerns combining the manufacture of cars, motor-cycles and pedal-cycles. In other parts of the country this combination was less usual.

The West Midlands, especially Coventry and Birmingham, took the lead partly because of historical accident, but mainly because of the diversified nature of the area's industrial life. In the local brass, screw, nut and bolt, paint, pressed-steel, tube, iron-foundry, leather, spring and plating trades, there was a multitude of small independent producers who could adapt themselves to the manufacture of motor parts. But at the outset these industries, unlike their counterparts in America, were not organized to produce standard components in quantity, and consequently the prerequisites

¹ Article on the "Automobile Industry" in the *Encyclopædia of the Social Sciences*, Vol. II, pp. 322 *et seq.*

for the large-scale production of finished vehicles were lacking. The West Midlands has remained the chief centre of the industry, although it suffered a decline in relative importance after the early twenties.

American manufacturers were quick to seize their opportunities. Although the French and the Germans had been pioneers in this industry, the motor vehicle in Europe long remained a luxury product of diverse design. The Americans, however, set out deliberately to produce a cheap standardized vehicle. In 1908 the Ford Motor Company began to concentrate on this type of vehicle, and by 1915 nearly three-quarters of the American output consisted of cars of under £200 in price. As a result of this manufacturing policy the size of the American firms became large and their numbers few, even before the First World War. In 1912, for example, half the American output was in the hands of seven manufacturers, and the total annual production had by that time risen to nearly half a million cars.¹ In England, the older manufacturing principles were adopted by motor firms. The number of producers was large and the output of each small. No attempt at standardization was made and frequent changes were effected in design. Consequently, prices remained high and by 1913 the great middle-class market had scarcely been touched. The British industry was then relatively small. Although the output of cars had more than doubled between 1907 and 1912, in the latter year it amounted to only 25,000 cars and commercial vehicles, about 5 per cent of the American output.² The British motor-cycle trade had developed more rapidly, and in 1912 it produced about 38,000 vehicles, a little more than half the American output.³ France was the only other important producer of cars and just before 1914 had an annual output of about 45,000.⁴ According to the Census of Production of 1912, the British motor and cycle industries together gave employment to about 92,000 persons; but unfortunately it is impossible to obtain figures showing employment in the motor industry alone.

¹ *Encyclopædia of the Social Sciences*, Vol. II, pp. 322 *et seq.*

² *Survey of Metal Industries*, p. 216. In 1913 the output was 34,000.

³ *Ibid.*, p. 225.

⁴ *Statistical Tables, etc.*, 1924-30, Part II, p. 4.

II

Expansion and International Competition, 1920-39

The First World War, coming at a time when the motor-car was just developing into an important means of transport, handicapped the growth of the industry in Great Britain. Some British firms continued to produce cars, but the majority of the existing plants were devoted to the production of aero-engines and shells, and the Government imported most of the vehicles it required from America. The United States was thus able to develop a great industry, not only for the purpose of serving the home market, but also to satisfy the growing foreign demand, without competition from outside. At the end of the war American manufacturers had achieved a position of unchallenged superiority. Their output had increased from 485,000 cars in 1913 to 2,205,000 in 1920.¹ The British output was stationary during this time and British manufacturers had lost the small export trade which had been developed before 1914. During the post-war boom manufacturers set themselves to cater for the urgent domestic demand for cars; but the legacy of the war had increased their difficulties in doing so. While they had been engaged on the production of aero-engines and munitions their plants had been extended, and improved machinery had been installed. But most of these plants had become unbalanced. For example, while additions had been made to the machine-shops during the war, body-shops and other departments had been neglected. It was, therefore, necessary to redress the balance, and this involved a large capital outlay at a time when money was dear and prices high. By the time that this investment had been made, the post-war slump had arrived, and as many firms previously engaged in other branches of engineering had turned to motor manufacture after 1918, the industry found itself in 1921 with a large excess of capacity over the supply which could be absorbed at the prices then ruling.

The industry soon recovered from this slump and made great progress during the rest of the twenties. The output of private cars rose from 32,000 in 1920 to 71,000 in 1923, more than twice the estimated output of 1912.² In the next six years there was a rapid advance which was associated with the adoption in a modified form

¹ *Encyclopædia of the Social Sciences*, Vol. II, pp. 322 *et seq.*

² These estimates of output are derived mainly from the annual reports of the Society of Motor Manufacturers and Traders; the reports are entitled *The Motor Industry of Great Britain*.

of American methods of manufacture by a few firms engaged in the production of cheap light cars. The output of private cars reached 132,000 in 1925 and 182,000 in 1929. Commercial vehicle production shared in this expansion and rose from 24,000 in 1923 to 56,000 in 1929. The output of motor-cycles grew from 80,000 to 146,000 in the same period. By July 1930 the number of insured persons in the motor, cycle and aircraft industries was nearly a quarter of a million, and the motor trade had by then achieved the position of a major British manufacture. In comparison with the United States, however, Great Britain's progress in this field was less striking. In 1929 the Americans turned out 5,358,000 cars and commercial vehicles, about four-fifths of the world's production. Canada then produced 263,000 cars, France 248,000 and Germany 128,000.

In international trade also, the disparity between Great Britain and the United States was equally great. Before 1914 exports of cars and commercial vehicles accounted for about a quarter of the total British production, but during the war the foreign markets were lost to the Americans and the British producers were able to obtain only a small share of the large foreign trade that developed during the twenties. The number of finished vehicles exported in 1929 was only 27,000, of which about 7,000 went to the Irish Free State. Most of the rest were sent to Empire markets where the British car enjoyed a tariff preference. The United States exports of cars and commercial vehicles (excluding vehicles exported in parts for assembly elsewhere) amounted in 1929 to 536,000, more than twice the total British *output*. In value the exports of the two countries (including their exports of parts and accessories) were £107 million and £11 million respectively. The British motor-cycle industry was much more successful in international competition. The American output of motor-cycles declined after the First World War because of the displacement of the cycle by the cheap car in the United States, and Great Britain became not merely the largest producer, but also the source of the bulk of the world exports. In the period from 1927 to 1929 the annual average export of motor-cycles from Great Britain amounted to nearly two-fifths of her total production. Up to the middle twenties sales were fairly evenly divided between the British Empire and foreign countries. After 1926, while exports to the British Empire remained stationary, those to foreign countries (mainly Europe) greatly increased. A large export of cycle engines to Europe also grew up.

In the early twenties the number of cars imported was in excess

of the number exported, but after the reimposition of protective duties in 1925, imports fell, and by 1929 foreign manufacturers supplied only about 5 per cent of the British demand. The imports consisted almost entirely of private cars, and nearly all of them came from four countries, the United States, Canada, France and Italy. Tariff policy affected both the quantity and the source of these imports. In 1915 an *ad valorem* duty of 33½ per cent had been imposed on the import of cars and motor-cycles,¹ and except for a brief period of free imports—from August 1924 to July 1925—this duty remained in force and was extended to cover chassis, parts and commercial vehicles. Countries of the British Empire were given preference over others. The result was to encourage foreign manufacturers to establish factories both in Great Britain and in Canada.

With the onset of the World Depression at the end of 1929 the output of the motor industry throughout the world contracted. In comparison with the American and other foreign producers, however, those of Great Britain were comparatively little affected. From an output of 5,358,000 vehicles in 1929 the United States production fell to 1,371,000 in 1932, and even in 1934 it was only 2,750,000. The Canadian output fell by three-quarters during this period, and the Continental industry also was badly affected. The progress of the British industry, however, was scarcely checked. In 1930 the very slight decline in the output of private cars was nearly offset by a rise in the output of commercial vehicles, and in 1933 the output of these two classes of vehicles was 286,000, about 50,000 more than in 1929.

The American industry recovered very slowly from the depression, and even in 1937, the best year of the thirties, output was 10 per cent less than in 1929 and it fell to under 2½ million in the following year. The British industry, however, steadily advanced, and in 1937 it turned out 379,000 private cars and 114,000 commercial vehicles. The ratio of British to American output thus increased from under 5 per cent in 1929 to over 10 per cent in 1937 and to nearly 18 per cent in 1938. Continental output made a substantial recovery, especially in Germany; but Great Britain remained well ahead of other European countries. In international trade, also, the disparity between the United States and Great Britain was reduced. British exports of cars and commercial vehicles in 1937 were more than twice those of 1929, while American exports failed to recover to the pre-depression quantity. Yet in 1937 they still numbered 395,000,

¹ These duties were known as the "McKenna duties."

equivalent to about four-fifths of the total British *output*.¹ The chief British markets were still found in the Empire, which took about four-fifths of the total vehicle exports from this country. Australia and New Zealand were the most important customers.

The motor-cycle trade was less fortunate than the car trade. Output was falling slightly even before the depression. It then dropped steeply, and in 1933 only 50,000 were produced. Even in 1937 the production was only 75,000, barely half the pre-depression number. The decline was due partly to the substitution of cheap cars for motor-cycles in the home market, but mainly to the fall in exports. In 1937 these had fallen to 25,000, about two-fifths of the exports in 1929. Losses in European markets through the rise of domestic production and the heavy decline in demand from Australia and New Zealand were mainly responsible. During the same period the formerly large export to Europe of motor-cycle engines was almost completely destroyed.

It is evident that, although there was some improvement in Great Britain's relative position in the motor industry during the thirties, this country did not succeed in obtaining a share in the world markets which her engineering prowess might have been expected to command. Only in the motor-cycle trade was superiority shown, and towards the end of the inter-war period this trade suffered an absolute decline. Since the advent of the motor-car meant a reduced demand for some of the former staple British exports, such as railway equipment, the failure of British motor manufacturers to gain a substantial proportion of the international trade meant a displacement of British exports by American.

The causes of Great Britain's inferiority in this industry must be further examined, for if the First World War conferred an initial advantage on the Americans, it cannot account for the subsequent disparity between the two countries. In some respects, indeed, the British motor manufacturers were especially favoured. Up to 1932 they were able to buy their materials in a free-trade market, while they themselves enjoyed substantial protection against foreign imports. Nor did the protection afforded by the British fiscal system end with the import duties. The tax levied upon the owner of a private car was based upon its power. It was not possible, however,

¹ The total value of the American exports (including parts and accessories) was £70,500,000 in 1937. This may be compared with the total for 1929 of £106,800,000. The corresponding figures for the U.K. were £15,900,000 for 1937 and £10,600,000 for 1929.

to tax the horse-power actually developed by an engine, and so a physical basis was chosen. The rated horse-power depended on the piston area divided by a constant, and this system of taxation affected design. Since the tax added considerably to the cost of maintaining a car, manufacturers were obliged to modify their designs with the object of reducing its burden. They received a further inducement to do this because insurance premiums bore a relation to the rated horse-power. Thus, the form of the tax exerted a distinct bias in favour of the small high-speed engine.¹ The type of engine produced by the American manufacturers, however, had a high-rated horse-power, and so additional protection was given by this system against the competition of the cheap American car. Yet it is doubtful whether, in the long run, this incidental protection was of advantage to the British manufacturers. If it helped them to preserve the home market, it handicapped them in their efforts to build up a foreign trade, for it was the high-powered large-bore engine which found favour overseas. Thus the rating system contributed to the weakness of Great Britain in export markets, into which she penetrated only where she was favoured by preferential duties. Further, that something was amiss with the native British industry is demonstrated by the fact that foreign firms found ample opportunities for manufacture within Great Britain. Indeed, no small part of the development within this country during the inter-war period can be attributed to them.

The relative improvement in the position of Great Britain during the thirties had several causes. First, in spite of heavy unemployment, real income per head rose in this country between 1929 and 1939. Because of the exceptionally favourable terms of trade, the British consumer during this time was able to satisfy his basic wants more cheaply than before, and so he had a surplus income available for expenditure on comforts and luxuries. The motor-car is a commodity for which the income-elasticity of demand is high, and this explains the buoyancy of home demand throughout the thirties. In the United States, on the other hand, the demand for cars before 1929 was already mainly a replacement demand. The stagnation of the American economy in the thirties and the failure of income per head to recover to the 1929 level, not merely restricted demand from new users, but also led existing car owners to refrain from replacing their vehicles as quickly as before. The American industry, with its

¹ Cf. A. E. Berriman, "A Review of the Rating Question" in the *Proceedings of the Institution of Automobile Engineers*, January 1925.

huge mass-production plants, was ill-adapted to meet such a situation, for unit costs rose steeply as sales fell. This accounts, in part, for the fall in American exports, since these could not be offered at low prices. As a consequence the competitive position of the British car overseas was improved. Further, budgetary difficulties caused many governments after 1931 to impose additional taxation on motor fuel. This increased the competitive strength of the British producer of small cars with high-speed engines and low petrol consumption. So what had previously been an obstacle to the British producer in his efforts to sell abroad now worked to his advantage. Nevertheless, these changes still left the British industry in a position of inferiority when compared with the American. The claim that an important cause of this inferiority was to be found in the defective organization of the British industry will be considered later.

III

Post-War Expansion and the Rise in Exports

During the Second World War the British motor industry was required to change over to the production of munitions, including tanks and vehicles for the armed forces, and the manufacture of private cars almost ceased. By the end of the war the firms found themselves with an enlarged manufacturing capacity, but their plants were unbalanced from the standpoint of peace-time production and little progress had been made in design. So the manufacturers had to re-tool their factories and to solve formidable problems of design and organization before they could resume production for their former markets. In these respects their experience during the First World War had been repeated. On the side of demand, however, they were more fortunate. A large and sustained volume of orders from abroad poured into the factories, and despite the continuance (until 1951) of petrol rationing and the imposition of a high purchase tax, the home market also remained buoyant. Indeed, although within four years output had been raised above the pre-war level, the industry found itself unable to satisfy the home demand and at the same time to serve the needs of foreign customers. As policy required that the latter should be given priority, supply for the home market had to be limited by administrative action. In practice, this meant that between 1948 and 1950 (inclusive) home sales accounted for

under 30 per cent of the output of private cars and for about 45 per cent of the output of commercial vehicles. For motor-cycles the proportion was about 53 per cent. Thus, whereas before the war exports (except those of motor-cycles) were of minor importance, the industry now became one of the chief participants in the export drive.

During the early post-war period it was difficult to believe that a high rate of exports could be maintained once Continental production had been fully restored and when the American producers had become less fully occupied with serving their vast home market. For some years after 1950, it is true, the number of complete cars and commercial vehicles exported slightly declined, but in the middle fifties it again expanded and in 1957 reached record figures. (See Table, page 205.)¹ Throughout this period, moreover, exports of parts and accessories, most of which were used in assembly factories abroad, and of other motor products grew even faster than those of completed vehicles. The combined effect of large export orders and an urgent home demand was a steep rise in the output of cars, commercial vehicles and motor-cycles. In 1957 the number produced in each category was over two and half times that of the pre-war period. Meanwhile, the industry had increased greatly the production of certain vehicles previously of minor importance, and it had added new products to its range. The outstanding development was in tractors, especially those for agricultural use. In pre-war days their output was small; between 1935-8 the average was 12,000 a year. The mechanization of agriculture during the war was accompanied by a growth in output which, after 1945 was very rapid indeed. By 1956 109,000 were produced of which 92,000 were exported. These tractor exports were equivalent in value to about half the commercial vehicle exports and to over a third the private car exports. Other varieties of vehicles introduced during this time included cross-country trucks. The motor-cycle industry, which in 1956-7 exported nearly three times as many units as in 1937-8, also extended its range of output by taking up the manufacture of auto-cycles and motor-scooters. Up to the middle fifties the home market for scooters

¹ The following figures illustrate the outstanding changes in the relative importance of the chief producing countries in international trade. In 1938 the British share of that trade (in number of cars) was 18 per cent. It rose to 55 per cent in 1950 and then, with the recovery of the Continental industries, it declined. In 1957 it was 30 per cent compared with West Germany's 36 per cent, France's 15 per cent and the U.S.A.'s 10 per cent. In commercial vehicles the British share rose from 9 per cent in 1938 to 28 per cent in 1957.

was supplied from imports, apart from some that were made under licence from Italian firms; but subsequently motor-cycle and other firms engaged in their manufacture on a considerable scale.

The success of the British producers in international trade after 1945 deserves further examination. Great Britain continued to benefit during the post-war period from preferential duties in various parts of the British Commonwealth, and in the middle fifties over half of the exports (in value) went to the Commonwealth and the Irish Republic. Australia and New Zealand remained outstanding markets, while Canada became an important new customer. Yet, although the Commonwealth markets were absolutely much larger than before the war, relatively they had declined. This was because of the remarkable growth in exports to Europe and to the United States. In 1957, when the growth was particularly rapid, 24 per cent of the total car exports (in number) went to Europe and nearly 23 per cent to the United States. The British have been conspicuously successful, especially in the European and North American markets, in cars with a cylinder capacity of 1,000 c.c. to 1,500 c.c., and they have also found valuable markets for sports cars and quality cars. Indeed, a distinct pattern of specialization among the main car-producing countries has become evident in recent years, with the Americans predominant in the manufacture of large cars, the Europeans in very small cars, and the British in medium and special types of cars.¹ For commercial vehicles the foreign markets are fairly widely distributed, although here also the

¹ This trend towards greater local specialization occurred at a time when the volume of production had become one of the most decisive factors in costs in the motor industry, and the fundamental economic influences which set the pattern of production for each country can be readily identified. The American superiority in the manufacture of very large cars can be attributed to the character of the home demand which, in turn, has been affected by the high level of personal incomes, the long distances covered annually by the typical car owner and the cheapness of petrol. It is true that recently those Americans who can afford two cars have been inclined to buy small and medium cars for town use, but the volume of such sales has not yet become large enough to persuade American firms to provide the heavy investment in the specific equipment required for the manufacture of those types, and so an opportunity has been given to British and Continental producers to supply that demand. The advantage of the Continental firms in the manufacture of very small cars lies in their low labour costs, compared with those of Britain and, of course, of the United States; for the proportion of labour costs to total costs rises the smaller the car produced. On the other hand, the fact that British incomes a head are higher than on the Continent means that demand in this country is directed towards medium rather than towards very small cars. The British superiority in quality cars can be attributed in part to the extreme preoccupation of both American and Continental producers with mass-production techniques.

chief customers are found in the Commonwealth, especially Australia, New Zealand, and South and West Africa. For agricultural tractors, for which the markets are very widespread, Europe has proved to be an even better customer than the Commonwealth.

Up to recently manufacturers in all countries have benefited by the upward trend of demand which since 1945 has been interrupted by only brief intervals of recession. The position of the British and the Continental producers might be seriously damaged if the Americans took up the manufacture of small and medium cars, and British firms would certainly be affected, though not necessarily for the worse, by the establishment of a free trade area in Europe.¹ Producers outside North America have been strengthened in their competition with the Americans by the world-wide shortage of dollars which has led to discrimination against American goods. In an assessment of future prospects it can be assumed that these conditions will not quickly disappear.

The import trade which during the thirties had supplied only a small proportion of the home demand, became of even less significance after the war. Between 1954 and 1956 the annual average imports (in number), most of which came from Europe, represented only about 1 per cent of home production, a figure which is not materially affected by the inclusion of parts imported for assembly in this country. As before the war the home market has been protected by an import duty which in the case of private cars amounted to 30 per cent *ad valorem*.

IV

The Organization of Production

Before the Second World War the three main products of the motor industry were private cars (including hackney carriages), commercial vehicles and motor-cycles. To these have been added since the war agricultural and other tractors. Other related goods turned out by the motor and motor-cycle firms are industrial and marine engines, aero-engines, trailers, motor-scooters and auto-cycles, apart from various engineering products that fall within the scope of other industries. Within each of the four main classes a variety of types is

¹ For an estimate of the effects on the motor industry of the establishment of a Free Trade Area and a Common Market in Europe, see The Economist Intelligence Unit, *Britain and Europe*, pp. 113 *et seq.*

produced. In the private car group the range is from small cars with a cylinder capacity not exceeding 1,000 c.c., most of which are sold (excluding purchase tax) for £400 or less, to luxury cars which cost some thousands of pounds. The extension of the British industry during the inter-war period was brought about mainly by the increasing sales of small and medium cars and this trend has continued until the present time. In 1956 cars with a cylinder capacity not exceeding 1,000 c.c. accounted for about 25 per cent of the new registrations and those not exceeding 1,600 c.c. for about 75 per cent. Within the several classes as defined by cylinder capacity there are numerous varieties of cars distinguished by the type of engine or body, from conventional saloons to sports cars and estate cars. In the commercial vehicle group there is a broad distinction between the passenger vehicle and the goods van or lorry; but within each of these divisions there are numerous types. Goods vehicles range from the light van to the ten-ton lorry. In 1956 about one-third of the new registrations were of vans not exceeding 16 cwt. and well over half were of those not exceeding one ton. Over the last twenty-five years there has been a growing tendency for the larger vehicles to be fitted with diesel engines instead of with petrol engines. For passenger vehicles, which are classified by seating capacity, the trend has been towards the production of larger vehicles, whereas for goods vehicles it has been towards an increase in the proportion of light vans used for local delivery. Most of the tractors produced are for agricultural use, but there are others used for general haulage.

The classification of vehicles by types does not wholly correspond to the pattern of specialization among the several firms. Indeed, the range of output differs from firm to firm and within each of them has varied from time to time. The reasons for these contrasts must be sought, in part, in the history of the industry. The manufacture of motor-cars can be traced to diverse origins. Some motor firms were originally cycle manufacturers who later took up the production of motor-cycles and motor-cars but long retained their previous trade. Others started their careers as manufacturers of sheep-shearing machinery, general engineers, electrical engineers, rifle manufacturers, shipbuilders, coining machinery manufacturers, or even silk weavers. Yet others came into being solely to produce motor-cars. At one time it was usual in Coventry, the original home of the industry, for the manufacture of cars, motor-cycles and cycles to be carried on not merely by the same firm but even in the same establishment, because there many of the firms had begun as cycle manu-

facturers. During the inter-war period firms tended to shed some of their secondary activities and to specialize more intensely. Pedal-cycles and motor-cycles became the concern of separate industries to an ever increasing extent, and a recent decision (1957) by the largest producer of motor-cycles to dispose of its pedal-cycle interests (though retaining the manufacture of cars), shows the tendency still at work.¹ Even though manufacturers themselves tended to fall into clearly defined groups, there was no uniformity in their scope of production. While some firms specialized on particular types of either private cars or commercial vehicles, others found advantage in combining the manufacture of these two classes, especially of vehicles which had units in common. Moreover, as markets for new types of products were created, some motor-car firms extended their range to include aero-engines, marine engines or tractors.

At one time the typical British motor manufacturer produced a small number of each of a wide variety of models. He aimed at catering for individual taste, both in chassis and coachwork, and he made frequent changes in his models. Such firms still exist and a high proportion of the most significant technical innovations have originated with them. But with the adoption in the middle twenties of methods of mass-production by a few British producers, and with the establishment in this country of branches of great American firms, the greater part of the industry passed into the hands of producers working on a very large scale. This process was accompanied by a reduction in the number of firms either by amalgamation or by liquidation. In 1920 there were 90 private car manufacturers. By 1929 the number had shrunk to 41, by 1939 to 33, and by 1946 to 32. Some of these were financially linked so that in the late forties there were not more than twenty independent organizations, among which six large groups, as before the war, held a dominant position in both the private car and the commercial vehicle trade.² Since then the process of concentration has been carried further, notably by the merging of the Nuffield and Austin interests in 1952.

The five great producers have been responsible for most of the growth in the production of cars, commercial vehicles and tractors during the last decade. At present they turn out nine-tenths of the output of private cars and tractors and a rather smaller proportion

¹ Statement circulated with *Report and Accounts of the Birmingham Small Arms Company*, November 1957.

² National Advisory Council for the Motor Manufacturing Industry, *Report on Proceedings* (October 16th, 1947), p. 8.

of the output of commercial vehicles.¹ The rest of the private car trade is in the hands of producers of quality or special-purpose cars, and in the commercial vehicle section there is a group of specialized firms concerned with the manufacture of heavy lorries. The scope of each of the major producers differs in detail. For instance, commercial vehicles form a higher proportion of Vauxhall's output than of that of other firms, while Ford and Standard (or its affiliated firms) are responsible for the Big Five's output of tractors. The same process of concentration has occurred in the motor-cycle industry where a single concern turns out three-fifths of the output.

The degree of concentration in the British motor industry is less impressive when it is compared with that in America, and the scale of manufacture is far smaller. Just before the Second World War, when the United States produced ten times as many cars as Great Britain, the three leading American companies turned out nearly 90 per cent of the total. General Motors alone, with an annual output of 1,400,000, produced over three times the British output and over twelve times the output of the largest British firm. But the comparison that is most significant is between the number of models. In the United States the three leading models accounted for 54 per cent of the total sales of cars, and the numbers of each model produced annually ranged from 350,000 to 600,000. In Great Britain the three leading models made up only 27 per cent of the sales (i.e. 81,000 cars in all). The three chief companies in the United States produced fifteen engine-types for their models. In Great Britain the manufacturers who were responsible for the same proportion of the smaller British output turned out thirty-nine different engine-types.²

Such comparisons as these are used to justify the claim that the superiority of the Americans in this industry has been due, first, to the huge size of the market and, second, to the standardization of their product which has enabled them to reap the full economies of mass-production. That a large volume of output of a standard product can greatly reduce costs in this industry has never been denied, and the economies to be achieved can be well illustrated by contrasting the methods of the old-fashioned British manufacturer with those of the mass-producer. The former, as we have seen, was

¹ Cf. G. Wansbrough, "Automobiles; The Mass Market" in *Lloyds Bank Review*, October 1955.

² L. Rostas, *Comparative Productivity in British and American Industry*, pp. 63 and 177.

accustomed to produce a wide range of models and to make frequent changes in design from year to year. This policy made long runs on the machines impossible. It prevented processes from being broken up into numerous operations and so necessitated the employment of much skilled labour. It required a large staff of designers and draughtsmen to plan the models and it made the cost of outside purchases of components and parts very expensive, since only small quantities of each type were required. The modern mass-producer on the other hand, who confines himself to a small range of models and who makes only small modifications in design from year to year, can reduce tooling costs per unit of output and can economize in the use of direct labour by introducing specialized and single-purpose machines. By long runs on the same product he can keep down setting-up and scrap costs, and he can buy parts and materials cheaply, since his suppliers' costs in turn are favourably affected by his large, standardized demands for their products. It was calculated that for a model produced in 1939 at the rate of 20,000 a year, a doubling of the output would lead to a reduction of 20 per cent in actual manufacturing costs, apart from the saving that would also be made in expenditure on materials and parts bought from outside suppliers.

Since the war the scale of production has risen considerably in Great Britain, and in spite of the proliferation of models, the number of basic types has been reduced by the mass-producers. Yet even now opportunities for further economies appear to exist, for it has been shown that the average scale of output of particular basic models is higher in Germany and France than in this country.¹ This argument has force; but it must not be pushed too far. The relation between economies of scale and the number of models is complicated by the fact that different models produced by a firm are made up, in greater or less degree, of common components and units so that variety may be offered without any considerable increase in costs. Moreover, certain standard components are now used by several manufacturers. This brings us to a consideration of the relations between the motor manufacturer and his suppliers.

The motor manufacturer is engaged on the production of a composite article for which he requires a wide variety of materials,

¹ In 1957 the two largest British firms had an average of six basic models, whereas the three largest Continental firms had an average of only three. All these firms had a broadly similar volume of output. (*Economist*, October 19th, 1957, Supplement, p. 3). In the tractor trade, on the other hand, the British have carried standardization and simplification further than the Continental producers.

parts and components. Many of the great American firms now find advantage in producing most of these in their own establishments. In England the practice varies between firms who buy the greater part of their semi-manufactured materials and components from independent suppliers, and those who are largely self-contained. It was estimated in 1946 that on an average not less than two-thirds of the factory-cost of a car was made up of the cost of supplies bought outside the firm.¹ Since then there has been a tendency for the motor manufacturers to undertake or to secure control over the production of certain components previously obtained from independent producers.² A notable example occurred when Ford acquired Briggs Motor Bodies in 1952. This movement towards vertical integration since the war can be explained largely by the fact that once a certain scale of finished output has been reached, the production of some types of components becomes ripe for new mass-production techniques, and the motor firms themselves have often been better placed to organize the adoption of those methods than the former suppliers. Even today, however, about 60 per cent, on an average, of the factory-value of a car is contributed by outside suppliers of parts and components. In the motor-cycle trade reliance on outside suppliers for finished components has always been important. Here the character of the components and units soon became more highly standardized than did the finished vehicle, and an opportunity was thus given to the assembler to build varying types of machines from such standardized components as he favoured. This is an illustration of the fact that the standardization of components is consistent with considerable variety in the finished products.

The degree to which components in the car trade have been standardized was emphasized in the report of the National Advisory Council for the Motor Manufacturing Industry just after the Second World War. There it was shown that dynamos and starters were supplied to the motor manufacturers by a firm that limited its output to three types of dynamos and two starters. One of the two carburettor manufacturers then turned out five different types of carburettor for twelve popular car models, and thirty-six of the seventy-nine parts used in these carburettors were common to all of them.³

¹ National Advisory Council for the Motor Manufacturing Industry, *op. cit.*, p. 11.

² This was comparable with the course of development in America where large parts-making enterprises were absorbed by the motor manufacturers.

³ National Advisory Council for the Motor Manufacturing Industry, *op. cit.*, p. 12.

Much the same could be said of batteries, wheel-drums and rims. These developments contributed largely to the cheapening of the motor-car in the years between the wars. It was claimed that this process could be carried much further if the variety in the finished car were reduced, and this is a policy which British manufacturers had begun to adopt just before the war and which they have been vigorously pursuing since 1945.

Over the last few decades the motor industry has taken the lead in developing new production techniques in the British engineering industry. As long ago as the middle twenties, a well-known motor engineer called attention to the contrasts between traditional production methods and those then being introduced by the mass-producers.¹ In the old-fashioned motor factory there were a number of distinct departments such as the machine-shop, the body-shop and the erecting shop, each of which was engaged on some specific process. In the machine-shop, machines of the same types were normally found together and were at work on the production of articles of varying kinds. These, on completion, were taken either to some central shop for inspection and assembly, or to a finished store from which they were drawn when required. According to the principles of "flow production," however, the articles to be manufactured move across the floor of the factory in a continuous stream, and at each stage in their progress they are subjected to some process of manufacture or assembly. Machines of the same type are not grouped together as in the typical engineering establishment; but they are so arranged that work can flow from operation to operation and that inspectors can be placed at intervals. In a motor-engine factory of this type, for example, the machine operations on the cylinder take place in a centrally situated shop, and the other parts move towards it in a stream, receiving at each stage in their progress some fresh operation. In the erection of the car similar principles are followed. A conveyor carries the work from one employee to another, and each workman confines himself to a specific operation. In this way the cost of internal transport is reduced and the time required for the productive process diminished. The finished store is eliminated from such factories, which can work with relatively small stocks of materials. "Flow production" renders the labour of the skilled machine operative and fitter unnecessary, and control

¹ F. G. Woollard, "Some Notes on British Methods of Continuous Production" in the *Proceedings of the Institution of Automobile Engineers*, February 1925.

over operations is facilitated; for the speed of the workmen is determined by that of the machines and conveyors. The mass-producer is able to provide his customers with spare parts and replacements more quickly and more cheaply than the small firm with a wide range of models.

Since the war these mass-production techniques have become far more elaborate than formerly. For instance, while automatic transfer machines have been known for a quarter of a century, they have become increasingly intricate and are nowadays more extensively used than in the past. In one factory a complicated machine performs about 160 operations on engine blocks and needs only two men to operate it. In another factory each automatic transfer machine is equipped with seventy cutting tools and produces a rear axle every half minute. In the pressing of bodies and in the various processes of assembly equally elaborate forms of organization and technique have been introduced.

Although the British motor industry is oligopolistic in structure, this has so far been compatible with keen rivalry among the several firms. Many of the suppliers of components and materials are monopolists or quasi-monopolists, notably the manufacturers of electrical equipment and of steel sheet and strip. In the manufacture of tyres there are several independent organizations, but price leadership rather than the processes of competition determine prices. Before the war the motor manufacturers were inclined to stress the influence of monopoly as a cause of the relatively high prices of these supplies, while the suppliers themselves found an explanation in the lack of uniformity of specifications and the small volume of orders for particular classes of goods, as compared with those received by their counterparts in the United States. The rise in the scale of output has removed the basis of this reproach, but it has, of course, not disturbed the monopolistic or oligopolistic organization of certain of the material and components trades. Yet since the major car producers can exercise great "countervailing power" in bargaining with their suppliers, and as there is now close collaboration between the two sides in securing the standardization and simplification of components, it would be rash to conclude that this structure has been detrimental to efficiency. But there are other aspects of the problem. Suppliers of components often sell to motor manufacturers at prices which are far lower than those at which they sell the same goods for distribution to the car user for replacement purposes. No doubt, in the absence of such types of price discrim-

ination, the motor manufacturers would have been charged higher prices for these goods, but this, of course, does not mean that the motorist himself benefits over the period for which he runs his car.

A corollary of the dependence of the motor manufacturers on trades supplying a wide variety of parts and materials is that any change in the fortunes of the motor industry has a far-reaching effect upon the whole economy of the country. This history of the motor trade in the present century illustrates this point. While many new trades came into being in consequence of the rise of the motor industry, and while others expanded, some old industries were damaged. All those that depended on horse traction decayed; for instance, the saddlery and harness trade declined after the First World War, and its producers changed over to new products, such as fancy leather goods and travel goods. During the twenties the jewellery trade attributed the fall in its volume of business to the change in personal expenditure brought about by the motor-car. The monopoly of the railways was broken, and their earning capacity much reduced by the same cause. On the other hand, the rubber, special steel and non-ferrous metal industries greatly benefited. Further, the rise of mass-production among motor manufacturers influenced the organization and technique of many ancient industries which adapted themselves to the production of motor components. Some of these trades adopted mass-production methods themselves in order to cater for the demand in quantity for standardized parts. The extension of die-casting and machine-moulding was brought about largely because of the increased demand for standardized motor castings. Mass-production methods were applied to the manufacture of lighting and starting sets. Laminated springs, once produced by smiths in small workshops, came to be turned out for the motor trade in factories which employed American methods of large-scale manufacture. The machine-tool industry, also, developed new methods of production in its effort to supply motor factories with the quantities of standardized machinery they needed. While the mass-production of motor-cars affected the organization of subsidiary industries, technical advances in many of these at the same time helped to raise the scale of production of the motor factories, and to reduce the price of the finished cars. For example, in the early twenties the bodies of cars were painted by skilled workers; as numerous coats were required and as the paint dried slowly, each body-shop had to be equipped with considerable space for storage. This process was, therefore, both long and expensive, and it was

difficult for a firm to deal with a large output. The introduction of solvents like nitro-cellulose as the bases of the paints and lacquers employed, entirely changed the methods of production. These types of paint could be sprayed on to the bodies with a gun, so that the need for skilled workers was obviated and the labour cost greatly diminished. As these cellulose paints dried very rapidly, the floor space required in the paint shop was reduced and the problem of storage ceased to arise. Thus, cheaper and speedier production was attained and the execution of mass-production programmes was facilitated.

The expansion of the industry was accompanied by a change in its location. With the application of mass-production techniques during the twenties there was a decline in the relative importance of the West Midlands as a centre for the assembly of cars, and by the middle thirties three of the six main producers turned out the greater part of their output in other places; Nuffield at Oxford, Ford (after 1929) at Dagenham, and Vauxhall (which was acquired by General Motors in 1927) at Luton. The change in location occurred chiefly because the mass-producers required large supplies of unskilled male labour for employment on conveyor-assembly, and they were no longer tied to the relatively expensive skilled labour centres.¹ The West Midlands retained most of the quality production, as well as some of the mass-production, and it was still the home of components manufacture. We have already observed, however, that many branches of that trade were also affected by mass-production techniques. Certain of them in which specialist firms had established an early predominance remained in the West Midlands (e.g. Lucas), but others, especially those branches of components manufacture in which the motor firms themselves were pioneers in the introduction of new methods, shifted towards the location of the main assembly plants. For instance, with the general adoption of the stamped steel body, Oxford and Dagenham became the leading body-production centres, and a similar type of locational change occurred when mass-production methods were applied to the manufacture of gears and radiators. For components and materials in the manufacture of which specialized skilled labour continued to be required the predominance of the West Midlands was not seriously challenged, and despite the changes that have been referred to, it still remains the chief centre of the industry. It is estimated that in 1954 the area em-

¹ M. Beesley, "Changing Locational Advantages in the British Motor Car Industry" in the *Journal of Industrial Economics*, October 1957.

played about two-fifths of the total labour force engaged in the manufacture of motor vehicles and parts.

V

The Market

The chief markets for motor vehicles are found in countries where income a head is high, and as income rises, there is a tendency for an increased proportion of it to be spent on these goods. In the United States where personal incomes are much higher than in the rest of the world, the demand for private cars a head of population is exceptionally large, but it has fluctuated violently with alternations of depression and prosperity. For instance, it grew rapidly during the era of "American prosperity" in the twenties and then declined steeply with the fall in incomes during the early and middle thirties. In Great Britain, on the other hand, where, in spite of the depressed condition of many industries, income a head increased during the thirties, the number of new car registrations continued to grow except in the worst years of the world slump. Since the Second World War the increase in the number of incomes in the middle range has raised the demand for private cars far above the pre-war level.

The size of the market for commercial vehicles is determined on the one hand by the volume of the traffic to be carried and on the other hand by the relative cost of transport by other means. During the inter-war years these vehicles provided a cheap and convenient alternative to rail transport for many classes of goods and for some types of passengers, and they have handled the greater part of the increased volume of traffic that has resulted from the country's enlarged production since the war. The market for tractors has been created by the mechanization of agriculture at home and abroad.

The domestic demand for private cars has been powerfully influenced by the cost of upkeep and running, in which the high price of petrol (because of the fuel tax), the annual vehicle tax and the insurance premium are important constituents. The burden has not prevented persons with very moderate incomes from buying cars. In 1952 there were only about 2 million incomes in excess of £750 gross, while the number of private car registrations was over 2½ million.¹ By 1956 the number of registrations was nearly 4 million. Even if one takes account of the rise in the number of in-

¹ G. Wansbrough, *loc. cit.*, p. 39.

comes above £750 a year since 1952 and of the cars purchased by business firms, it is clear that car owners include many persons with incomes that are lower than the average weekly earnings of male manual wage earners in the more highly paid manufacturing industries. Although the presence of hire-purchase facilities and of a supply of second-hand cars enables the poorer owners to satisfy their demands at a relatively low initial capital outlay, the cost of running a car remains high for all owners.

The expansion of the income group which is just within the margin of the potential car-owning class is obviously of critical importance in determining the growth of the industry. Other factors include the rate of replacement and scrapping which, in turn, is related to general economic conditions, the prices at which new cars are offered for sale, the age distribution of the existing stock of cars in use, and the rate of progress in design and performance. Many of these factors are mutually dependent. For instance, since costs in motor manufacture are sensitive not merely to economies of scale but also to economies of "running full," price trends are liable to be much affected by both long-run and short-run changes in general economic conditions. Furthermore, a fall in the price of new cars will not only cause a more rapid replacement of existing cars, but by communicating itself to the second-hand market will make effective new levels of demand.

One of the chief obstacles to growth has been the heavy taxation already referred to, and the trade has been critical of this burden. Since, after 1931, the sum raised by fuel and vehicle taxes was larger than that spent on the upkeep and extension of the roads, it would seem that there was some justification for its claims. The form of the tax, moreover, was open to grave objection, for it diverted demand from the class of vehicle which would otherwise have been preferred, and it also distorted design. In the case of the private car, the horse-power tax damped down demand for the larger cars in favour of those with a low rating. A strong body of opinion favoured the replacement of this tax by one which did not discriminate against the large car, and it could be convincingly argued that the distortion of engine-design brought about by the tax created obstacles for the export trade. Since the overseas demand was for a car fitted with a large-bore engine, the motor manufacturers were, in the existing conditions, unable to reap the economies of producing a car which suited home and export buyers alike. Yet the manufacturers were not unanimous in this demand, since some of them feared that United

States competition would become keener in this country if the cost of upkeep of the large-bore American car were reduced by a change in the rating system. Even after the Second World War, manufacturers were slow in making up their minds about the type of tax preferred; but as a result of their recommendations a tax on cylinder capacity was substituted in 1947 for the old tax. This was considered to have a less distorting effect on design, but it still discriminated against the large car. Finally, in January 1948, a flat-rate registration fee, identical for all types of new cars, was introduced, for by this time it was clear that nothing which handicapped the export of British cars must be allowed to persist. The change certainly had beneficial effects upon engine design. Since the war the high purchase tax has further distorted demand, but this was deliberate since one of the main objects of the tax was to divert sales to the export market.¹

In the market for commercial vehicles, where taxation is by weight in the case of vans and lorries, and by seating capacity for passenger vehicles, Government policy in the thirties was concerned mainly with *restricting* total demand; although it is true that the large increase in taxation on very heavy vehicles in 1934 also *diverted* demand—from heavy to light goods vehicles. Of even greater importance than the tax burden, however, were the provisions of the Road Traffic Act of 1930 and the Road and Rail Traffic Act of 1933. These Acts, which were designed to weaken the road operators in competition with the railways, imposed a restrictive licensing system administered by Area Traffic Commissioners. Their effect was certainly to reduce the demand for commercial vehicles below what it would otherwise have been. In addition, they probably tended to concentrate the demand for passenger vehicles on those of large seating capacity, and to divert demand from the heavier lorries, such as are commonly operated by public carriers, to the lighter lorries and vans owned by manufacturing and wholesale firms who were not subject to restrictions provided that their vehicles carried only their own goods. The nationalization of the railways and of long-distance road transport by the Transport Act of 1947 probably strengthened these tendencies; but the market for commercial vehicles (both for passengers and goods) is likely to be strongly influenced by more recent changes in transport policy. The Transport Act of 1953 embodied the principle that the allocation of traffic between rail and road should be by competitive processes rather than

¹ The purchase tax has ranged between 33½ and 66⅔ of the wholesaler's price.

by centralized administrative decision.¹ The railways were freed from the disabilities that formerly handicapped them in their competition with roads, and the licensing of the road operators was made less restrictive. When a new system of railway rates has been fully worked out and applied, there may be some important changes in the allocation of traffic, although it would be surprising if the expansion in road haulage were seriously checked.

In most branches of engineering the manufacturer sells direct to the user, since the unit of sale is costly and the purchaser is fully equipped with technical knowledge. In the sale of commercial vehicles this practice is common, for customers frequently consist of municipalities, railways and large contractors, and an order is given in such cases only after some kind of test of the vehicles has been made by an expert representative. But the distribution of private cars and the smaller commercial vehicles takes place through retailers or agents, because, unlike most other products of the kind and price, sales of these types of car are made, not to technical experts, but to the general public. The functions of these distributors deserve notice. In the early days of the industry manufacturers adopted many devices for advertising their products. Cars were exhibited at agricultural and other shows, and trials and races were held. Further, manufacturers induced coachbuilders, cycle-agents and other retailers who had the requisite accommodation to exhibit and sell cars, and from this origin the modern dealers arose. There are now about 8,000 of them, and they fall into three groups, distributors, whose territory is very extensive, area or main dealers, and retail dealers. Each type of dealer can sell cars direct to customers, but if a distributor or main dealer makes a sale, he draws full commission on it, while if the sale is affected through a retail dealer the commission is divided. The distributor and the main dealer contract with the manufacturer to undertake certain specified obligations, such as the carrying of stocks and the provision of a minimum display area and of facilities and expertise for servicing. Until recently only dealers who held a manufacturer's franchise were supposed to sell his cars, and the grant of the franchise was restricted. Since 1957, however, any dealer who satisfies the conditions laid down by a

¹ The Act of 1953 also provided for the denationalization of the business of carrying goods by road. The Transport Act of 1956, however, empowered the British Transport Commission to retain the lorries (about 7,000) required to maintain a trunk network. See, G. Walker, "Competition in Transport as an Instrument of Policy" in the *Economic Journal*, September, 1956, pp. 411-12.

manufacturer can sell the latter's cars and is entitled to a commission.¹ Apart from these dealers, there are numerous motor repair shops which combine the sale of cars with their main business of servicing and of selling petrol and oil.

Before the war, competition among manufacturers gave the dealers a powerful bargaining position in relation to their suppliers, but during the long period after 1945 when the output was insufficient to meet the home demand, the manufacturers' strategic position improved and the supply of new cars to dealers was in fact rationed. It is true that the dealers' margin has remained high (about 17½ per cent of the basic retail price, exclusive of purchase tax), but he has had to assume more onerous obligations than formerly.

Although there have been no price-fixing agreements among the manufacturers themselves, they have been parties to a powerful organization designed to maintain the retail prices which each of them has determined. This is the British Motor Trade Association which was formed, under a slightly different name, in 1913 from among manufacturers, wholesalers and retailers. It covers most classes of accessories, as well as the complete car, and it has an elaborate body of rules to which members must conform. Until recently, no member might deal in cars produced by manufacturers outside the Association, and manufacturing members supplied only member-dealers. Any dealer who was found to have sold a car at less than the list price fixed by its manufacturer was liable to be fined or, in extreme cases, to be placed on the Stop List. As an ultimate sanction the Stop List was very powerful, for a dealer whose name was on it could not obtain supplies from any member of the Association.² These arrangements were similar to those carried out by many of the associations formed for resale price maintenance among producers of, and traders in, proprietary goods; but in the motor industry they were particularly important because of the relation between second-hand and new car sales. A high proportion of the sales of new cars takes place under conditions of "trading in," that is, the buyer of a new car expects the agent to take his old one in part-exchange and to deduct the value of the latter from the selling price. Since agents are in competition with one another, they are under an inducement to give a generous allowance for the car

¹ Even so, a dealer without a franchise cannot stock the manufacturer's cars and his commission is lower than that given to the enfranchised dealer.

² Board of Trade, *Report of Committee on Resale Price Maintenance*, pp. 76-80.

that is "traded in" so as to obtain the sale. To do this is equivalent to selling under the list price, and the agent with low selling costs thus passes some of the benefit of these low costs to the public. This has been regarded as reprehensible by the motor trade, and in 1935 when the "used car problem" had come to be looked on as a serious menace to the policy of resale price maintenance, the Association began to issue a list of maximum allowances which might be given on second-hand cars "traded in." At the end of the Second World War the Association introduced a Covenant Scheme under which buyers of new cars undertook not to sell their cars for twelve months. This was intended to prevent buyers from reselling at prices far above the original prices during a period of scarcity when the relation between new and second-hand prices had become abnormal. In the motor-cycle trade the British Cycle and Motor-cycle Manufacturers and Traders Union formerly operated a scheme of resale price maintenance similar to that in the motor-car trade.¹ It prescribed, moreover, that a discount of 20 per cent off the list price should be allowed to the dealer.

These methods have been abandoned as the result of the Restrictive Practices Act of 1956 which, *inter alia*, prohibited the collective enforcement of resale price maintenance, although it strengthened individual resale price maintenance by making it possible for manufacturers to take legal action against price-cutters. The rules of the motor trade have been modified to take account of these changes in law. Whether the same results will be achieved by other means is still to be seen.²

Methods of sale in foreign markets have greatly altered in the course of the industry's development. In its early days manufacturers were content to rely upon firms of general export merchants who conducted the whole business from the appointment of agents abroad to the financing of the consignments. General merchants, however, became reluctant to buy on their own account. Many firms, therefore, came to depend upon distributing houses which specialized upon the export of motor vehicles and accessories and handled competing makes. Later some of the larger firms set up subsidiary companies in their chief markets to act as central depots, and appointed sub-dealers in the various localities. Others traded through

¹ *Ibid.*, p. 75. The Union has been re-named The British Cycle and Motor-cycle Industries Ltd.

² See, an illuminating article in the *Economist*, February 22nd, 1958, pp. 683-5.

main and sub-dealers, as they did at home, and sent out representatives to keep them informed about the requirements of the markets and to supervise the work of the agents. Detailed control by manufacturers over their selling in foreign markets became usual with the concentration of output in a few great firms. The creation and maintenance of an export trade depend closely upon the ability of the local car owner to obtain spare parts quickly when he needs them, and firms are obliged to ensure that this provision is ample.

In recent years the sales organization of British firms, especially in the United States, has been much improved, partly through the efforts of manufacturers in this country and partly through the initiative of local firms of distributors. A notable advance occurred when General Motors decided to import the smaller model produced by Vauxhall and to distribute it through the same organization that markets Pontiacs and Buicks.

For most of the period since the Second World War the marketing conditions faced by the industry have been in sharp contrast with those of pre-war years. This applies particularly to the spread of demand throughout the year. In the inter-war period the industry had to meet a highly seasonal demand. For private cars, sales were high during the last quarter of the year. They fell off in January and there was a quiet period of trade until March. Then followed the peak period of demand, and there was good trade until July when a slack season which lasted until October began. For goods vehicles the demand was fairly evenly spread throughout the year, although there was a slack season in August and September. For passenger vehicles, on the other hand, demand was highly concentrated in the spring and early summer, and for motor-cycles in the period from March to July. It is not difficult to account for these fluctuations. The dull period at the beginning of the year and the peak in the spring and early summer could be attributed mainly to the climate and to the peculiarities of the licensing system. Owners of motor vehicles usually take out either yearly or quarterly licences. The latter, however, do not run for the three months from the time when they are obtained, but they cover the normal quarterly periods.¹ This was an inducement to buyers of such private cars and motor-cycles as were wanted for the spring and summer to defer their purchases until after March 25th; for in this way they avoided payment of tax for the previous quarter, when, owing to weather condi-

¹ This feature of the licensing system has recently been modified.

tions, the vehicles might not be much in use. Thus, the dullness in trade in the winter months was intensified by the licensing system and the seasonal improvement in the early spring delayed. The other important cause of seasonal variations in the distribution of demand was the Motor Show. As manufacturers were accustomed to bring out new models and to announce price changes in October, when the Show was usually held, buying ceased towards the end of the summer. For two months after the Show firms were busy with orders booked from the public and from agents in anticipation of the demand.

These seasonal fluctuations in sales were communicated to production, for motor-cars cannot be stocked without great risk and expense. Consequently, unemployment in the industry was usually highest in September and usually lowest in April and May. The export trade had less effect than might have been expected on stability of demand. It certainly helped to relieve the winter slackness, since the export peak came in December and January; but it intensified the spring demand and did nothing to alleviate the slackness in the summer.¹ The seasonality of the export trade can be explained by reference to the geographical distribution of markets and by the effect of the Motor Show on the timing of overseas no less than of home buying. For motor-cycles, where the export market also did little to relieve the seasonality of home demand, the effect on production was mitigated by the possibility of making for stock.

The seasonal fluctuations in demand largely disappeared during the period in which the output was insufficient to satisfy the home demand, but they have now in large measure returned. The increased importance of the export trade and the wider distribution of markets have brought only slight relief. Motor manufacturers, however, have tried to eliminate the seasonal effect of the Motor Show by their decision to announce changes in models or prices at other times during the year.

In the past the motor industry was much affected by fashion and this, like the seasonal character of the demand, increased the risk of stocking. From time to time in the course of the industry's development models succeeded in winning the public favour only to be superseded by others within a very short time. This led to serious fluctuations in the fortunes of particular firms. In any new industry technical progress is likely to lead to frequent changes of design, and it is to be expected that firms responsible for each step in that

¹ C. Saunders, *Seasonal Variations in Employment*, p. 62.

progress will reap the benefits of their alertness. But alterations in design were more frequent than technical advances warranted. Faced with a fickle demand, the several manufacturers sought to capture public taste by making frequent changes in design which did not always embody any technical improvement. The multiplication of models was also a form of insurance against the vagaries of demand. Firms were accustomed to produce a complete programme of new models every year in the hope that one at least would take

PRODUCTION OF MOTOR VEHICLES¹
(in thousands)

<i>Year</i>	<i>Private Cars and Taxis</i>	<i>Commercial Vehicles</i>	<i>Agricultural Tractors</i>	<i>Motor Cycles</i>
1913 ...	34		—	—
1923 ...	71	24	—	80
1925 ...	132	35	—	120
1929 ...	182	56	—	146
1930 ...	170	67	—	126
1931 ...	159	67	4	75
1932 ...	171	61	3	71
1933 ...	221	66	3	50
1934 ...	257	86	4	—
1935 ...	325	92	9	65
1936 ...	367	114	13	—
1937 ...	379	114	18	75
1938 ...	341	104	10	—
1939 ...	305	97	10	—
1945 ...	17	122	18	—
1946 ...	219	148	28	93
1947 ...	287	157	56	112
1948 ...	335	177	114	131
1949 ...	412	218	88	153
1950 ...	523	263	117	171
1951 ...	476	259	137	172
1952 ...	448	242	123	158
1953 ...	595	240	109	154
1954 ...	769	270	134	180
1955 ...	898	341	133	178
1956 ...	708	299	109	125
1957 ...	861	288	144	175

¹ Year ended September from 1927 to 1934; for the rest calendar years. Tractors include 3- and 4-wheeled types. (Sources: Society of Motor Manufacturers and Traders; British Cycle and Motor-Cycle Manufacturers' and Traders' Union; and *Monthly Digest of Statistics*.)

the public fancy. The economies to be derived from mass-production are, of course, seriously jeopardized by frequent changes in design and by a multiplicity of basic models. It is possible, as we have seen, to provide variety in the private car by the skilful use of common units and components, and to this extent to reconcile the technical requirements of mass-production with the satisfaction of a capricious or discriminating demand. But the conflict remains and is not likely

EXPORTS OF NEW MOTOR VEHICLES¹
(in thousands)

Year	Private Cars and Taxis	Commercial Vehicles	Chassis		Tractors	Motor-Cycles and Tri-cars
			Private Cars	Commercial Vehicles		
1926-9 (avge.)	18	2	16		—	—
1929	24	3	10	6	—	62
1930	19	4	4	3	—	43
1931	17	2	2	3	—	23
1932	27	2	5	6	—	20
1933	34	2	7	8	1	18
1934	35	3	9	11	1	16
1935	44	3	10	11	4	18
1936	51	4	14	14	7	20
1937	54	4	24	17	11	25
1938	44	5	24	11	6	20
1939	43	2	23	9	—	19
1946	70	23	17	23	13	53
1947	126	24	17	26	17	55
1948	195	37	32	38	69	75
1949	219	45	39	48	65	65
1950	344	75	55	71	87	74
1951	309	68	60	69	116	82
1952	276	62	34	66	107	70
1953	271	45	38	60	95	63
1954	323	50	50	69	111	70
1955	340	62	51	78	107	61
1956	309	52	28	75	92	59
1957	401	58	24	64	113	50

¹ Before 1953 station wagons (estate cars) were included with commercial vehicles, afterwards with private cars; industrial trucks excluded after the war. Up to and including 1933 the figures for private cars include some used vehicles. Tractors include tracklayers, wheeled and horticultural types; in number tracklayers have recently accounted for only about 2 per cent of the total. Source: as in previous table.

to be completely removed. Furthermore, the possibilities of important advances in technique and design are always present, and mass-producers have to take account of these before committing themselves to heavy investments. The risk is obviously reduced when the volume of output is so large that the specific assets can be quickly amortized.

CHAPTER VIII

TEXTILES: A GENERAL SURVEY

Among the British manufacturing industries of the inter-war period the textile group was second only to the metal and engineering group in the amount of employment which it afforded, and in July 1939 the number of insured persons in it was 1,107,000. This was at the end of a long period of decline, for in 1924 the number insured was 1,327,000; and a much higher proportion of the workers was unemployed at the end of this period than at the beginning. After 1939 there was a further decrease, and by July 1946 the number of insured workers was only 750,000. A tendency for the relative importance of textiles to decline had long been observed; but up to 1914 this had not prevented a large absolute expansion from taking place from decade to decade. The First World War, however, checked their growth, for they were unprotected from recruiting and hampered by the shortage of raw materials. By 1924 the numbers engaged in textile manufactures were substantially less than before the war, and from then onwards they were seriously affected by the losses sustained by the United Kingdom in her international trade. During the thirties these losses were exceptionally severe. The further fall that occurred after 1939 is attributable to the restrictions on the production of textiles during the Second World War and to the diversion of labour to the war industries. After the war, at a time when demand for the products of the industry was very strong, the reconstruction of the labour force was hampered by the difficulty of recruiting the large numbers required in the conditions of full employment that prevailed in the economy as a whole. Even in 1951, when employment in textiles reached its post-war maximum, the numbers engaged in the industry were considerably less than in 1935. Since then they have fallen, and in 1957 textiles employed only about 10 per cent of the total labour in manufacturing industry, compared with 12 per cent in 1951 and 15 per cent in 1939. This comparison affords a reasonably accurate indication of the decline in the importance of textiles in the British economy during recent years, a decline that is, as we have seen, in continuance of a long tendency.

The experiences of the several trades of which the textile group is composed differed greatly over the last forty years. The major industries in the group (cotton and wool, which together with textile finishing accounted for nearly three-quarters of the total employment in 1924) declined very steeply during the inter-war period. Some other industries, jute, linen and lace, also gave less employment in 1939 than in 1924. On the other hand, the carpet, hosiery and rayon trades grew substantially. The result was that in 1939 cotton, wool and textile finishing were responsible for little more than three-fifths of total textile employment. Since the war

ESTIMATED NUMBER OF INSURED WORKERS IN THE TEXTILE INDUSTRIES¹

(in thousands)

	July 1924	July 1929	July 1939	July 1946	July 1948
Cotton Spinning	572	555	193	135	153
Cotton Weaving			185	105	116
Woollen and Worsted			214	147	177
Silk Spinning and Manufacture,	42	74			
Rayon Weaving, etc.			50	35	36
Rayon, Nylon Yarn, etc.			24	21	39
Linen	83	80	72	58	60
Jute	41	39	28	16	18
Hemp, Rope, etc.	21	19	19	19	19
Hosiery	94	106	121	73	86
Lace	20	17	14	7	10
Carpets	27	25	31	13	21
Other Textiles	44	45	62	58	60
Textile Bleaching, Printing, Dye- ing, etc.	121	116	94	63	75
TOTAL	1,327	1,315	1,107	750	870

¹ The figures for the inter-war years, though they give a broad indication of the changes that occurred, are not strictly comparable with one another. The figures for 1924 cover persons aged 16 and over; those for 1929 and 1939 cover persons aged 16 to 64 inclusive. The figures for 1946 cover males aged 14 to 64 inclusive and females aged 14 to 59 inclusive. Non-manual workers earning £250-420 a year who were not insurable in 1939 became insurable for the first time in 1940. The figures in this table cover Great Britain and Northern Ireland. They are not comparable with those in the table on p. 210 *infra*, which covers only Great Britain and is based on the New Industrial Classification introduced in 1948. The figure for 1948 includes an estimate for Northern Ireland for which comparable figures were not available for that year.

these tendencies have been confirmed. There has been an expansion in man-made fibres manufacture (including pure synthetics like nylon and Terylene), narrow fabrics, made-up household textiles and miscellaneous textiles. In hosiery and carpets there has been little change, and employment has declined steeply in cotton spinning and weaving, in linen and, to a less extent, in wool, lace and jute. Within each of these industries there have been important changes. For instance, the cotton industry now uses a much higher proportion of man-made fibres than formerly; staple fibre in the spinning mills, and spun rayon yarn and continuous filament in the weaving sheds.

Most of the changes in the relative importance of the different branches of this group of industries as well as in their place in the economy as a whole, have been associated with the fall in exports, especially of cotton goods. Up to 1914 textiles were still Britain's chief export commodity. In 1913 over a third of the total exports (and nearly 44 per cent of the manufactured exports) consisted of textiles. Cotton yarn and manufactures alone accounted for 24 per cent of the total. In spite of the steep decline in textile exports between the wars, in 1937 they still made up nearly a quarter of the total trade. The proportion supplied by the cotton industry had fallen to 13 per cent, but even so cotton exports were still larger than any other single item in the export list, with the exception of machinery. The Second World War carried the decline much further and by the middle fifties textiles accounted for little more than a tenth of the total exports. This decline was chiefly due to the steep rise in exports of metal and engineering goods on the one hand and to the absolute fall in the exports of cotton goods on the other, a fall which the increase in other textile exports was quite insufficient to offset. In 1955 cotton manufactures, including yarn, thread and piece goods, accounted for only four per cent of the total exports compared with 13 per cent in 1937.¹ Thus the textile industries, once the outstanding contributors to the country's exports, are now primarily concerned with catering for the home market, a market which, in recent years, they have had to share increasingly with foreign manufacturers.

The home market itself is very diverse. Textiles are manufactured not only for clothing, furnishings and household uses, but also, on a very large scale, for industrial purposes. It is estimated that at present about 45 per cent of the output is used for clothing, 25 per cent

¹ If rayon manufactures other than filament yarn are included the proportions are 4·8 per cent and 13·9 per cent.

for household goods and 30 per cent for industrial purposes. Since the war the industrial market has grown more rapidly than the others. In countries with a high income a head the income elasticity of demand for clothing is low. Consequently, where population is growing slowly, the prospects for a large extension of trade with that sector of the home market are unfavourable. On the other hand, the industrial demand is linked with the progress of some rapidly growing industries (for example, motor tyre manufacture), and unless this market is jeopardized by substitutes, such as plastic materials, demand is likely to continue to expand. So far as export prospects are concerned, the British industry must face increasing threats from the rise of the manufacture in previously underdeveloped countries where labour costs are low, and the main opportunities are likely to be found in the sale of specialities in which experience and skill still confer advantages.

NUMBERS EMPLOYED IN THE TEXTILE INDUSTRIES IN GREAT BRITAIN¹

(in thousands)

(End of July)

<i>Industry</i>	1949	1951	1952	1954	1957	1958
Cotton Spinning and Doubling	180	186	150	170	147	132
Cotton Weaving	142	145	114	126	101	94
Woollen and Worsted	211	210	186	211	206	189
Rayon, Nylon, etc. Production	46	47	30	38	40	34
Rayon, Nylon etc. Weaving and Silk	43	52	46	54	48	44
Linen and Soft Hemp	12	15	13	12	9	6
Jute	18	18	16	20	18	15
Rope, Twine and Net	18	15	14	15	14	13
Hosiery and Knitted Goods ...	118	125	109	127	122	116
Lace	14	14	10	10	10	9
Carpets	26	29	25	30	31	32
Narrow Fabrics	22	23	19	24	22	20
Made-up Textiles	20	23	25	27	25	27
Textile Finishing	84	91	83	93	86	85
Other Textile Industries ...	21	28	28	31	31	31
TOTAL ...	975	1,021	868	988	910	847

¹ The figures in this table cover Great Britain only, and they are not comparable with the figures in the table on p. 208, *supra*. Source: *Ministry of Labour Gazette*.

CHAPTER IX

COTTON

I

A Century of Growth

In its development and structure the British cotton industry is characteristic of that period of economic change which a few historians are still prepared to call the era of the industrial revolution. Its early growth was closely associated with certain fundamental technical inventions which involved the extensive employment of power machinery and the emergence of the factory. It has long provided economists with "the classical example of territorial centralization."¹ In the expansion of foreign trade during the nineteenth century it had a particularly large share, and for this reason the cotton interests were for many years able to exercise a powerful influence over the commercial policy of the country. Throughout this period its predominance in one market after another was overthrown as foreign industries arose; yet it was supremely successful in adjusting itself to the altered conditions of demand, and in finding alternative outlets for its produce. In the cotton trade the industrial individualism of the nineteenth century found its most complete expression. Its organization, far from depending on a conscious plan, was, as Marshall declared, largely "automatic" in character.² We cannot wonder that interpreters of the nineteenth-century economic system, as well as its bitterest critics, turned to cotton, more than to any other industry, for illustrations of their economic principles and for data on which to base their generalizations.

Detailed accounts of the rise of this industry abound,³ and no attempt to deal comprehensively with its history will be made here. But a few of the main features of its development may be referred to, since they have a bearing on its present condition. The change in

¹ C. R. Fay, *Great Britain from Adam Smith to the Present Day*, p. 289.

² Marshall, *Industry and Trade*, p. 602.

³ For example, A. P. Wadsworth and J. de L. Mann, *The Cotton Trade and Industrial Lancashire*; G. W. Daniels, *The Early English Cotton Industry*; and S. J. Chapman, *The Lancashire Cotton Industry*.

habits of consumption which followed the introduction of East Indian cottons into Europe during the seventeenth century had created conditions of demand favourable to the rise of a substantial industry; but a technical transformation of the old hand processes was necessary before full advantage could be taken of the new opportunities presented by this change of fashion. This condition was satisfied during the latter half of the eighteenth century as a result of a series of important inventions. New forms of spinning machinery, which permitted the utilization of water and steam power, were accompanied by improved mechanical devices for performing the preparatory processes, such as carding, by new methods of printing calico, by chemical discoveries which assisted the finishing trades, and finally, after 1793, by the introduction into America of Whitney's cotton-gin which, by accelerating the process of separating the seeds from the fibre, cheapened the raw material. The new technique of production changed the organization of the industry. By 1800 cotton-spinning had become to a large extent a factory trade, although it was not until after 1815 that steam power could be said to have displaced water power.¹ In the weaving branch the change came later. Cartwright's power-loom was patented in 1787; but this machine was not a commercial success, and it was not until 1822 that a power-loom capable of competing with the hand-loom was placed on the market.² After 1830 the number of hand-loom declined, and weaving passed into the mills; but not before 1860 was the hand-loom weaver finally superseded in this industry. It is evident that the cotton trade came under the domination of power machinery and of the factory much earlier than most other British industries. During the latter half of the nineteenth century many detailed improvements in technique were effected; but there were no new fundamental inventions to exercise a transforming influence over organization and methods such as occurred in the other great industries of the country.

The leading position which Great Britain secured in this industry towards the end of the eighteenth century may be attributed to a variety of causes. Her great mercantile and colonial developments placed her in a strong position both for obtaining supplies of raw cotton and for serving foreign customers. Owing to the nature of

¹ Moreover, a satisfactory "self-acting" mule constructed of metal, was not invented till 1825.

² Cf. A. P. Usher, *An Introduction to the Industrial History of England*, p. 302. "The power-loom . . . did not attain even approximately its modern form until 1841."

this raw material, and to its low cost of transport, there was no reason why manufacture should necessarily take place where it was grown. Moreover, the countries producing it were not then ripe for industrial development. Great Britain had certain natural advantages, in her humid climate, her water power and coal supplies, and in her contemporary engineering and metallurgical developments, for working out a new technique of production. Older centres of the industry, like India, were handicapped by their social systems in adopting the new manufacturing methods, and economic development in Europe was retarded by political troubles.

The new cotton industry was from the first concentrated mainly in Lancashire and the adjoining counties. It is difficult, as in the case of every industry which does not depend on a local raw material, to explain the causes of the original settlement; but "the external and internal economies of a growing industry, combined with the presence of a suitable climate, a convenient port and coal supplies, are sufficient to explain its persistence and development,"¹ Concentration became more intense as time went on, and in 1921 85 per cent of the persons engaged in the British cotton industry were to be found in Lancashire and in the adjacent parts of Cheshire and Derbyshire.² Most of the remainder were in the West Riding and Scotland. The geographical distribution of the industry has been only slightly modified, in spite of the vicissitudes of the last forty years.

The new productive technique enabled the cotton trade to expand its output with great rapidity throughout the nineteenth century. Since the industry depends entirely on foreign countries for its raw cotton, the order of magnitude of its growth may be judged from the increase in the imports of that material. In 1800-4 the annual average of retained imports amounted to 56 million pounds weight; in 1820-4 to 152 million pounds; in 1850-4 to 707 million pounds; and in 1900-4 to 1,580 million pounds.³ Although the cotton industry was susceptible to cyclical trade fluctuations, yet if successive quinquennial averages of imports are compared it is found that on three occasions only was progress checked. The most serious fall in imports occurred in 1860-4, the period of the Lancashire Cotton Famine caused by the American Civil War. The other two occasions

¹ J. Jewkes, "The Localization of the Cotton Industry" in *Economic History*, January 1930, p. 91.

² Census, 1921, *Industry Tables*.

³ Committee on Industry and Trade, *Survey of Textile Industries*, p. 142.

consisted of the years 1875-9 and 1885-9, and they were associated with the depreciation of silver and the more active international competition from which Great Britain was then beginning to suffer. Lancashire shared to the full in the great recovery of the staple British industries after the turn of the century. Annual imports of raw cotton rose from 1,580 million pounds in 1900-4 to over 2,000 million pounds in 1910-13.¹ These import figures do not indicate the full extent of the industry's expansion after 1900; for, as it was concentrating to an increasing extent on the finer yarns and cloths, the value of the product increased faster than the rate of imports. This expansion of trade was associated with the great increase in British exports in the decade before the First World War, to which reference was made in the first chapter. At that time it appears that the terms on which agricultural and manufacturing populations were exchanging their respective goods were becoming more favourable to the former. The purchasing power of agricultural peoples was growing in consequence, and the cotton trade, for which they constituted the leading customers, grew accordingly.²

The expansion of the industry is also shown by the increase in its equipment. In 1885 the number of spindles in Lancashire was 42½ million. Numbers grew slowly during the next fifteen years, not only because the industry's rate of expansion was being retarded, but also because output per spindle was then being increased by technical improvements. After 1900 the growth was rapid, and in 1914 there were over 59 million spindles, nearly 44 per cent more than in 1885. The number of looms rose from 546,000 in 1885 to 649,000 in 1900, and to 805,000 in 1914.³ Employment in the industry grew more slowly. In 1851 it reached 570,000, a figure which was not afterwards attained in the nineteenth century. In the decades immediately following 1851 there was a large decline in employment, and this may be attributed to the supersession of domestic weavers and of small weaving sheds by larger mills, which required less labour per unit of output. At the same time machinery was becoming increasingly efficient and, in some degree, children were displaced by the more productive adult workers. By 1900 these methods of economizing labour had apparently reached their limit; for there followed a great rise in the numbers engaged, from 544,000 in 1901

¹ *Ibid.*, p. 142.

² Cf. F. W. Taussig, *International Trade*, Chap. XXI. The change in the terms of trade, as already mentioned, was associated with an increase in the exports of capital during this period.

³ *Survey of Textile Industries*, p. 142.

to 620,000 in 1911.¹ A reduction in the length of the normal working week may have been one cause of this increase.

Early in its history the cotton industry developed a large foreign trade, and by 1815 its exports were far greater in value than those of the woollen and worsted industry which, for centuries, had easily held the first place. By 1835-40 the annual average value of the cotton exports amounted to only just under half of the total British exports,² and with the abolition of the remaining import duties on raw cotton and the advent of the Free Trade era, the progress of the industry as an exporter became increasingly rapid. As was to be expected, the proportion of cotton exports to the total declined as Britain developed a more diversified foreign trade. But cotton retained its leading position. In 1913 the value of its exports amounted to nearly one-quarter of the whole British export trade. It has been estimated that about three-quarters of the total output of this industry was exported in the years immediately before the First World War, apart from the yarns which were sent abroad in the form of lace and hosiery.³

A considerable change occurred during the nineteenth century, both in the composition of this foreign trade and in the markets to which the goods were sent. Up to 1850 exports of yarns represented between one-third and one-half of the value of piece-goods exported annually; but the proportion declined until in 1910-13 the value of the piece-goods was nearly five times that of the yarns and finished thread. Exports of yarns (in weight) reached their absolute maximum in 1885-9. The cause of the decline in the importance of yarn in the cotton export trade is revealed by an examination of the leading markets. In 1820 nearly all the yarn exported went to supply the weavers of Europe; but a machine-spinning industry developed on the Continent in the next twenty years, and after 1840 exports to this market increased only to a slight extent. Meanwhile a demand for British yarn had arisen in the East, and by 1880 about half the yarn exports were going to India, the East Indies, China, Japan and the Near East. But during the next twenty years spinning mills were established in these countries and exports to them declined. By this time the European market had recovered; but its demand was now for fine yarns for the hosiery and speciality trades rather than for

¹ Census Reports. Owing to changes in classification the figures afford only a rough indication of growth.

² J. H. Clapham, *Economic History of Modern Britain, 1820-50*, p. 479.

³ *Board of Trade Journal*, May 3rd, 1923, p. 531.

the staple yarns which it had taken earlier in the century. Just before the First World War about 60 per cent of the yarn exported went to the continent of Europe.¹

In the larger piece-goods trade also, Europe was the chief market in the early years of the nineteenth century. In 1820 it took over half the total exports (in linear yards). North and South America together came second in importance, with nearly a third of the total. But soon both the Continent and the United States established weaving mills and protected them by tariffs against British competition. Consequently, exports to Europe increased slowly and irregularly during the remainder of the century. The United States remained a good customer only until the Civil War, when its own manufacturers captured the trade. In 1910-11 Europe (except Turkey) took only 6 per cent of the exports of piece-goods and the United States about 1 per cent. With the decline in the importance of Europe as a market in the early nineteenth century, South, Central and North America (excluding the United States) took the lead. Demand from this continent continued to expand until the nineties, but its relative importance was soon eclipsed as a result of the rise of the Eastern trade. This had begun to grow very quickly in the second quarter of the nineteenth century, and by 1860 the British East Indies took 31 per cent of the exports of piece-goods, the Far East 12 per cent and the Near East and Africa 13 per cent. By 1900 these three groups of markets were together responsible for nearly three-quarters of Lancashire's total exports (in yards). In 1913 the percentage distribution of piece-goods was as follows:

British India	...	...	43.2	United States and Canada	...	2.2
China and Japan	...	...	10.9	Australia and New Zealand	...	3.0
South-east Asia	...	...	7.6	Europe (except Balkans)	...	5.5
Balkans and Near East	...	...	6.8	North Africa	...	5.1
South and Central America	...	...	10.6	West, East and South Africa	...	5.1

Thus, before the First World War, piece-goods, unlike yarns which were mainly exported to Europe, found their chief and most rapidly growing markets in distant countries, particularly in Asia, where the populations were still mainly agricultural in their pursuits. In value, the distribution of the exports was rather different from that shown in the table, since a large proportion of the exports to India consisted of unbleached goods of low quality, whereas the Dominion and American customers bought the higher priced cloth.

¹ Figures in this and subsequent paragraphs are based on tables in *Survey of Textile Industries*, pp. 146 *et seq.*

The place of Lancashire in the world's cotton industry throughout this period may be measured by reference to the cotton consumption of the different countries, or to their capacity. The first criterion, however, was becoming increasingly unsatisfactory during the fifty years before 1914. While the new producing countries were concentrating on the lower counts of yarn, the quality of the average British product was becoming finer. The yarn produced in Lancashire mills, therefore, was of higher value per pound than that of other countries, and the weight of raw materials consumed was scarcely a good basis for comparison. Productive capacity provided a better measuring-rod. In 1881-4 Great Britain possessed nearly 54 per cent of the world's spindleage; the Continent had 28 per cent, and the United States 16 per cent. By 1913, although the absolute number had risen, the British proportion had fallen to 39 per cent, while the Continental share had risen to 30 per cent and the American to 22 per cent. These three areas thus accounted for 91 per cent of the world's spinning capacity. Of the remainder, India had over 4 per cent and Japan under 2 per cent. Weaving capacity was more difficult to compare, since in the East hand-loom weavers were still in the majority and even in Europe had not entirely disappeared. It is estimated, however, that Great Britain had 29 per cent of the world's power-loom weavers, followed by the United States with 25 per cent.

The changes in Lancashire's share of the world's international trade are of greater significance than the changes in her share of capacity or output; for, while Lancashire depended in an extreme degree on foreign markets, most of the production of other countries was consumed locally. Although the British proportion of the world's output of yarns and piece-goods was declining, her share in international trade during the first decade of the twentieth century showed only a slight fall. In 1909-13 it amounted in value to about 65 per cent of the total.¹ If the British cotton industry was declining in relative importance, this was due, not to the competition of other exporting nations, but to the growth in several countries of an industry to serve their own needs. And the relative decline of an industry is of small account when it is accompanied by a great increase in absolute magnitude. In 1913 Lancashire could look back on a century of almost uninterrupted expansion. Her exports were far greater than the sum of the cotton exports of the rest of the world, and they were still growing very fast. The decade before the First World War was particularly prosperous, and it appeared that

¹ *Survey of Textile Industries*, p. 61.

the "marked slackening of progress, apparently approaching something like stagnation,"¹ which could be observed during the last quarter of the nineteenth century, was in reality merely a temporary phase preceding a period of unexampled prosperity.

II

"Lancashire under the Hammer"

With the outbreak of war the expansion of the cotton trade ceased. Between 1914 and 1920 spindle and loom capacity was stationary and the labour force slightly declined. Owing to the shortage of shipping, cotton producers found difficulty in securing supplies of raw material and in serving their foreign customers, particularly those in the more distant markets. From June 1917 to February 1919 the trade was under the control of a committee, the Cotton Control Board, composed of representatives of the employers, the trade unions and the Government. This Board rationed the limited supply of cotton by fixing the maximum percentage of machinery to be worked in each establishment.² Production was largely concentrated on the higher grade goods, and "it was early made plain that the low quality cloths on which there was least profit and which demanded most ship-space would be dropped almost altogether."³ Asian customers for low quality fabrics had, therefore, to turn elsewhere for their supplies.

Immediately after 1918 an urgent demand for Lancashire goods arose, especially from Eastern markets where purchasing power had been raised by the appreciation of silver. As it was impossible to expand capacity and output sufficiently to meet these demands, a period of unprecedentedly high profits resulted. Spinners whose net profit on spinning medium counts had been just over a halfpenny a pound in 1912 received 1s. 6d. a pound in the early months of 1920, and manufacturers benefited in a corresponding degree.⁴ The boom was essentially a price boom. Output remained well below the 1913 level. Towards the end of 1920 the boom broke. Prices and output fell to very low levels in 1921, and although there was a recovery in the next few years, even in 1924 the output of yarn (in weight) was

¹ W. J. Ashley, *The Tariff Problem*, p. 61.

² H. D. Henderson, *The Cotton Control Board*.

³ B. Bowker, *Lancashire Under the Hammer*, p. 49.

⁴ *Ibid.*, p. 34.

30 per cent less and the output of piece-goods (in yardage) was nearly 33 per cent less than in 1912. Export figures indicate the same trend. In 1921-3 the annual average of yarn exports was only 75 per cent, and of piece-goods under 59 per cent, of those of 1910-13. Some improvement occurred in 1924 and in 1925; but those years marked the highest export level reached in the inter-war period, and subsequently the decline was progressive. Although exports of yarn were maintained throughout the rest of the decade, those of piece-goods dropped steadily and in 1929 they were nearly a fifth less than in 1924. During the World Depression they fell catastrophically, and even the slight recovery that took place after the depreciation of sterling in 1931 was not maintained during the rest of the decade. In 1937, the best year of the thirties, the quantity of piece-goods exported was only 52 per cent of that in 1929 and only 29 per cent of that in the period immediately before the First World War. In 1938 there was a further decline. Yarn exports had not suffered quite so seriously; but even they failed to regain the level of 1929 and in 1937 they amounted to only 73 per cent of the annual average exports of the period 1910-13.

As home demand was well maintained during the twenties and thirties, and was, indeed, greater than in 1914, the industry lost its distinction of being predominantly an export industry, and in 1937-8 foreign and home sales of piece-goods were about equal in

Year	Production		Machinery in Place		Employment in Spinning, Doubling ⁴ and Weaving (in (thousands)
	Yarn ¹ (in million lb.)	Piece-goods ² (in million sq. yds.)	Spindles ³ (in millions)	Looms (in thousands)	
1912	1,963	8,050	61	786	622
1924	1,395	6,046	63	792	499
1930	1,048	3,500	63	700	356
1937	1,375	4,288	44	505	361
1938	1,070	3,126	42	495	288

¹ Including spun rayon yarn.

² Including rayon piece-goods and mixtures woven in cotton sheds. The figure for 1912 is in linear yards.

³ Mule equivalents—i.e. a ring spindle is taken as equivalent to 1½ mule spindles. Figures for 1912-30 are approximate.

⁴ Average number of insured workers actually in employment for 1924-38; aged 16 or over for 1924 and aged 16 to 64 for 1930-8. The figure for 1912 shows the number actually employed.

quantity.¹ The contraction in the output, equipment and labour force is shown in the above table.² It would be difficult to find in the economic history of any country another example of a great industry that suffered in a corresponding period a contraction of this magnitude, in the absence of any revolution in technique.

The decline in the British cotton industry may be compared with what happened abroad. Up to 1924 this country appeared to have suffered, though to an exaggerated extent, from misfortunes common to this industry all over the world, for at that time world consumption of raw cotton and international trade in cotton goods were lower than they had been in 1913.³ After 1924 the industry outside the United Kingdom recovered, and in 1929 world consumption of raw cotton was greater than in 1913. It fell during the Great Depression and then rose during the later thirties well above that of 1929. The result was that Great Britain's share of world consumption, which had been about one-fifth before 1914, was reduced to less than one-tenth on the eve of the Second World War. Her share of the spindleage, which had amounted to 40 per cent of the world's total in 1900 and 35 per cent in the later twenties, had fallen to 25 per cent.⁴ Thus, the cotton industry in Great Britain had contracted during a period in which in the world as a whole it had made an advance, though not a very great advance.

International trade was everywhere depressed throughout these years. World trade in cotton yarns, which in 1924 was much lower than in 1913, declined still further after then, and in 1934-8 it was only half that of the years immediately before the First World War.⁵ Great Britain had retained her share of this diminished total. But in the far more important piece-goods trade her experience had been very different. World exports of this commodity were somewhat lower during the later twenties than before 1914, but this decline was accounted for wholly by the shrinkage in British exports, for those of other countries had increased. In 1909-13 the British share of the world's international trade in piece-goods was 65 per cent; in 1928-9 it was only 44 per cent. During the next decade international trade

¹ This statement applies to all classes of textiles produced in cotton-weaving sheds; that is to say, it covers rayon piece-goods and mixtures as well as cotton piece-goods.

² *Working Party Report on Cotton*, pp. 6 and 7.

³ Committee on Industry and Trade, *Survey of Textile Industries*, pp. 72, 154.

⁴ International Federation of Master Cotton Spinners, *International Cotton Bulletin*.

⁵ G. Blau, *World Fibre Survey* (F.A.O. Report, 1947), p. 69.

in piece-goods again fell sharply, while Britain's share of it by 1937-8 dropped to under 26 per cent.¹ Thus the outstanding features of the cotton industry between 1913 and 1939 were, first, the decrease in international trade as a whole, with the result that on the eve of the Second World War over four-fifths of the world's consumption of cotton textiles was supplied by local industries, and second, a steep decline in the British proportion of the diminished total.²

The loss of exports was the sole cause of the shrinkage in the British industry. Yet even home demand increased only slightly during this period in which both population and income a head grew substantially. This experience, which is similar to that of other Western countries, suggests that cotton textiles are goods for which the income elasticity of demand in those countries is low. Yet the British industry was able to some extent to adjust itself to the changes in the direction of expenditure in the home market. Spinners occupied themselves in producing increased quantities of yarns for the expanding hosiery trade, and in the thirties they began to spin staple fibre. The weavers turned to the manufacture of rayon and mixed fabrics. By 1937-8, for example, the output of rayon piece-goods and mixtures was equivalent in quantity to 14 per cent of the output of cotton piece-goods, whereas in the early twenties the production of the former had been insignificant. But the rise of an export of rayon piece-goods and mixtures was not sufficient to provide adequate compensation for the heavy losses sustained in the main classes of goods. It is true that the decline in the value of the exports (when allowance is made for the change in the value of money) was not as great as the decline in square yardage. But this is merely a corollary of the fact that the chief losses occurred in the cheaper lines of goods and in the countries whose purchases were chiefly of the lower qualities. Those losses, indeed, were suffered mainly in exports to India, China, the Balkans and the Near East. As India and the Far East took over 60 per cent and the Balkans and the Near East 7 per cent of the total British piece-goods exports in 1913, the main source of the trouble is easy to discover. In 1929 exports to India were only 42 per cent, to China and Japan only 29

¹ *Working Party Report on Cotton*, p. 119.

² The relation between world output and the volume of international trade is shown by the following indices:

	1913	1928	1937
World Consumption of Raw Cotton ...	100	118	136
International Trade in Cotton Goods ...	100	88	62

(Source: *Working Party Report on Cotton*, p. 119.)

per cent, and to the Balkans and the Near East only 47 per cent of those of 1913. About seven-eighths of the British losses had been sustained in those markets. In the next decade additional losses in the same markets were mainly responsible for the further decline that occurred. For instance, exports to India fell from 1,374 million square yards in 1929 to 356 million square yards in 1937. Nevertheless, in this decade the fall in exports was widely spread, and the Dominions and Colonies were the only large markets to show an increase, and that a very slight one.¹

The chief cause of the decline was the growth of home production in countries previously supplied by Great Britain; a secondary cause was the successful competition of Japan in international trade. This generalization can be illustrated by an examination of the course of events in what was once by far the most important British market, namely India. Just before the First World War mill production in India amounted to 1,164 million yards of piece-goods, and Great Britain supplied that market with 3,068 million yards out of a total import of 3,159 million yards. Even if account is taken of hand-loom production, which was estimated at 1,068 million yards, Great Britain then supplied nearly three-fifths of India's total consumption of cotton textiles. By the late thirties India's mill production had risen to such an extent that she was able to supply all but 13 per cent of her much increased consumption, and by 1934-8 her total imports had fallen to an annual average of 770 million yards. But if Great Britain had lost her Indian trade mainly through the rise in Indian production, her share of the reduced imports had at the same time been greatly diminished through Japanese competition. On the eve of the Second World War she was supplying barely 300 million yards, a tenth of the amount she supplied twenty-five years earlier, and substantially less than the Japanese. The same story was repeated in many other markets. Broadly, two-thirds of the British export losses could be attributed to the development by former customers of their own industries and one-third to the successful competition of Japan.²

In some countries the ruin of the British trade was assisted by increases in tariffs or by import restrictions. The raising of the Indian tariff in 1930 and again in 1931 was a contributory cause of the transference of custom to the Indian producers. British exports to Brazil and to the United States were practically destroyed by increases in

¹ *Working Party Report on Cotton*, pp. 118-20.

² *Ibid.*, p. 5.

import duties. Yet the effect of the tariffs can easily be over-estimated, and it must be remembered that Japan was subject to even more onerous restrictions during the thirties. For instance, British cotton goods received a preference in the Indian import tariff over foreign, including Japanese, goods, and yet the Japanese trade did not suffer so severely. In other countries also there was discrimination in favour of British producers. These included the Dominions (which granted the home country tariff preferences), certain British Colonies (where after 1934 imports of foreign textiles were restricted by quota), and a number of European and South American countries (where during the thirties the British textile trade benefited from reciprocal trade arrangements). In this preferential area British exports were more than maintained during the thirties, and the share of the total trade taken by that area rose from 25 per cent in 1929 to 54 per cent in 1937. There is little use in speculating on what Great Britain's cotton exports would have been in a free trade world; but it is relevant to point out that the weapon of trade protection was not everywhere used to the disadvantage of Lancashire. Yet, the markets in which the discrimination could be effectively introduced so as to favour British exports were not those which had initially been the most important, and so this policy could not arrest the British decline.

Since the British losses cannot be attributed mainly to the increase in protective duties, an explanation must be sought elsewhere. The predominant cause was the diffusion over a large part of the world of technical methods and organization that had been worked out in the West, especially in Great Britain. This diffusion was bound to occur sooner or later as a result of the impact of Western ideas on the more primitive agricultural societies. The concentration in this country of cotton manufacturing to supply the needs of distant markets was the consequence of her having been a pioneer in new methods of production. As foreigners learned to use these methods, Great Britain was bound to lose her supremacy, for she possessed no natural or acquired advantages which could enable her to preserve her position. Most countries have a tradition of cotton manufacturing—in Japan and India it was a very ancient tradition—and the production of many classes of cotton goods does not make exorbitant demands on technical skill, nor is the machinery required of a highly complicated type. Once the Asian manufacturers had solved their problems of technique and organization, they had advantages over Lancashire in their supplies of very cheap labour. China and India were also producers of raw cotton. Huge markets were at hand.

But the inevitable transference of a large part of the industry from Lancashire to Oriental countries was certainly accelerated by other causes, some of which have already been mentioned. The First World War, by interrupting British supplies, gave an initial stimulus to the home producers. In the case of India, the fall in the exchange value of the rupee after 1920 made imports dear; and the Non-Co-operation Movement brought with it periodical boycotts of British goods. The effect of the increase in import duties has already been discussed. Throughout the raw-material-producing areas of the world, moreover, the market for British textiles was affected during the inter-war period by the violent changes in the terms of trade that occurred. A given quantity of agricultural products in 1939 exchanged for a much smaller quantity of manufactured goods than they did in 1913, or even in 1924. This change reduced the power of agricultural consumers to purchase foreign manufactures. They were compelled by these price changes to manufacture their own cottons or to buy cheap goods from Japan as a substitute for those formerly supplied by Lancashire.

Meanwhile, marked improvements had occurred in the efficiency of these foreign industries. After 1926, for example, the Japanese cotton industry was reorganized and re-equipped, and between 1926 and 1935 the annual output per worker in the spinning mills rose from 5,700 pounds to 9,300 pounds, and in the weaving sheds from 22,300 yards to 49,500 yards.¹ At the same time wages were reduced, because the depression in Japanese agriculture and in the silk industry enlarged the supply of female workers at a time when the demand for them was growing very slowly because of industrial rationalization. In the quota-ridden world of the thirties even Japan's markets for cotton were unstable, but her low costs enabled her to find new outlets to replace those in which her progress was checked. Lancashire, for her part, could find no adequate compensation for her losses. It would, of course, be wrong to imagine that Japan's gains in foreign markets were wholly at the expense of Great Britain. The low prices at which her products were offered not only displaced exports from other countries, but also created new demands. Many Asian consumers who could not have afforded Lancashire's products, or who would have bought them only in very small quantities, were drawn into the market by Japan's low prices.

¹ Cf. G. C. Allen, "Japanese Industry: Its Organization and Development to 1937," in E. B. Schumpeter (Ed.), *The Industrialization of Japan and Manchukuo*, pp. 649 *et seq.*

It has been shown that while Lancashire lost much of her former trade in cheap bulk goods supplied to the poorer countries, she did much better in her exports of high quality goods to the richer countries. This meant that her losses measured in value were not as great as those measured in quantity. In consequence, the incidence of the chronic depression fell unevenly on the various sections of the industry. The spinners of the finer counts, the manufacturers of the higher quality fabrics, and the finishers, suffered less damage than the producers of low count yarns and cheap “grey” fabrics. Up to the late twenties, indeed, the fine spinners were comparatively prosperous, especially as their export trade to the continent of Europe was well maintained. After 1928 they, too, became depressed, although never to the same extent as the part of the American section that spun the low counts. During the thirties the export of yarn, though it declined, did not suffer as much as the export of piece-goods, and a high proportion of the yarn exports was of fine quality. Among the weavers, the producers of coarse fabrics suffered the most severe blows; but since manufacturers do not specialize to the same extent as spinners, the depression was more evenly spread over their branch, and some relief was possible because they were able to turn to the manufacture of rayon and mixed fabrics. Nevertheless, it was disquieting to observe during the inter-war years that not merely did the depression steadily deepen but that its scope widened. Foreign competition which had begun in low quality goods gradually crept up the scale, and by 1939 only the highest quality goods were unaffected by it. This experience was not confined to Lancashire. For instance, Japan had first developed an export trade in coarse yarns. She lost this in the early twenties to the Chinese and Indians, and replaced it by exports of cheap fabrics. After 1933, however, this trade in turn was threatened by the competition of local producers in her former markets, and from then on the tendency was for an increasing proportion of her exports to fall within the range of the higher qualities.¹ It seems probable that the tendency for an ever greater part of the demand for the cheaper goods to be met by local producers will continue and that international trade in cotton textiles will in the future consist mainly of specialities. This conclusion has a bearing on the problem of organization and technique in the cotton industry—a problem which is considered in sections IV and V.

¹ G. C. Allen, “Japanese Industry etc.” in E. B. Schumpeter (Ed.), *op. cit.*, pp. 578–82.

III

The Second World War and After

During the Second World War the cotton industry was subject to severe restrictions on its raw materials and productive capacity. In 1939 and 1940 the disposal of the output was controlled so as to give priority to export and Government demands. Later, production was curtailed so as to save shipping space and to provide labour and factories for the war industries. In 1941 the Concentration of Production policy was applied to the industry with the result that 40 per cent of the spinning and weaving capacity then operating was closed. At the same time, the character of production was altered by the contraction of the export trade and by adjustments made to meet the requirements of the Service departments and the "Utility" scheme. The output of cotton yarn fell from 1,092 million pounds in 1939 to 597 million pounds in 1945, and the output of cotton cloth (excluding mixtures) from 3,640 million yards in 1937 to 1,539 million yards in 1945. The number of insured persons in employment in cotton spinning and weaving declined from 349,000 to 209,000 between July 1939 and July 1945. The export trade had meanwhile become very small. Yarn exports fell from 159 million pounds in 1937 to 16 million pounds in 1945, and piece-goods exports from 1,921 million square yards to 424 million square yards during the same period.

When the war came to an end the shrunken industry was faced with an immense demand both at home and abroad. But the labour force that remained in the industry was wholly insufficient for the production required. Because of the buoyant demand for labour in the economy as a whole, it was difficult for the industry to recover the workers who had left it during the war. As many of the remaining workers were old, moreover, retirements were numerous, and a large annual recruitment was necessary merely to maintain the existing establishment. In fact, after the first post-war year, the net annual recruitment never exceeded five per cent of the labour force, and even by the end of 1951 employment in spinning and weaving was only 297,000, 50,000 less than before the war.¹ Although production rose as the industry was deconcentrated and as labour returned, yarn output in 1951 (including spun rayon yarn and mixtures)

¹ R. Robson, *The Cotton Industry in Britain*, pp. 14, 247.

was only 78 per cent of that of 1937 and piece-goods output only 68 per cent. The rationing of clothing in the United Kingdom was retained until 1949 with the object of diverting supplies to foreign markets, but in that year, when a post-war record was achieved, exports of yarn and piece-goods were little more than half those of 1937.

During this early post-war period the failure of the export trade to recover could be plausibly attributed simply to an inability to turn out supplies which in turn was due to the shortage of labour. This was an obstacle which, it then seemed, could in time be surmounted. But the foundations of the world's cotton industry had been gravely disturbed to Lancashire's ultimate disadvantage. During the war in most of the chief cotton manufacturing countries there had been a steep fall in production. Much of the Japanese capacity had been destroyed and in Europe the industry was completely disorganized. Elsewhere, however, a great expansion had occurred. The United States enlarged her industry and greatly increased her exports. In the former importing countries capacity had grown with the result that after the war they were much less dependent upon imports. It is significant that whereas in the chief war-afflicted areas raw cotton consumption fell from an annual average of 16.9 million bales during 1934-8 to 9.7 million bales in 1946-7, in the rest of the world it rose from 11.05 million bales to 16.65 million bales. In other words, raw cotton consumption in the world as a whole fell only slightly in spite of the steep decline in the industries of the former chief manufacturing countries. It was, of course, among the countries in which manufacturing capacity had expanded that Great Britain had found her chief customers before the war.¹

These tendencies persisted after 1945. In the United States output and exports remained at a much higher level than during the thirties, and the former importing countries became still more self-contained. Meanwhile, Europe restored her production to the pre-war amount and Japan made a considerable though by no means complete recovery. The general effect was that, while world production in 1951 exceeded the pre-war level, total exports were about twenty per cent less. As during the inter-war period, Great Britain was the chief victim of this decline in the international cotton trade.

The onset of a textile slump in 1952 marked the beginning of a new phase in the history of the post-war industry, and the British position deteriorated further, relatively and absolutely. Indeed,

¹ G. Blau, *op. cit.*, p. 74.

whereas other countries soon recovered, in Britain another secular decline began. Her share of international trade fell steeply and in 1957 her exports of piece-goods were only half those of 1949. What is particularly striking is that her producers now found their home market seriously menaced by imports. Considerable quantities of cloth had been imported to meet the shortages of the early post-war years, but most of these imports were of grey cloth for re-export after processing. They declined during the recession, but after 1954 they rose again and most of them were retained in the home market. The chief suppliers were India and Hong Kong which, under the Ottawa Treaty, can send these goods free of duty into the United Kingdom. In 1957 the imports amounted to 415 million square yards of cloth and 15 million pounds of yarn. Nearly two-thirds of this import, equivalent to about 15 per cent of the home consumption of cotton textiles, was retained in the home market. During some months of 1957 and 1958 imports in quantity, though not in value, exceeded exports, a relation that would have seemed inconceivable even a few years ago. In 1957 the British production of cotton and rayon cloth was less than half the pre-war amount and her exports barely a third. The yarn trade had fallen in about the same proportion. Rayon goods and mixtures produced by the cotton industry now form a much higher proportion of the output and exports than they did before the war, for in many uses they have been substituted for pure cotton fabrics.

The decline in output led to marked reductions in man-power and equipment. By the beginning of 1957 employment in cotton spinning and weaving had fallen to about a quarter of a million from a post-war peak of over 300,000. The number of spindles and of looms in place fell by about a third, and of those that remained about the same proportion was idle. The structural changes in the industry in response to this contraction will be examined latter.

IV

The Structure of the Industry

In contrast with the integrated structure of the iron and steel industry, the constituent parts of the cotton trade are characterized by extreme specialization of function. In spite of recent modifications presently to be described, the Lancashire industry is still highly

sectionalized and is conducted for the most part by a large number of independent firms, each of which confines itself to a narrow range of activities within a particular stage. There are not only numerous horizontal divisions according to process, but also many vertical divisions between firms engaged in the same stage of manufacture or marketing. The extent to which the industry is subdivided will be realized if we trace in outline the course of a supply of American cotton from the time it comes into the possession of the Lancashire trade, through the various manufacturing processes, until the finished product is finally sold.

Before 1939 the Liverpool importing merchant bought his cotton either through his own local representative at an American cotton port or distributing centre, or from samples offered to him by the agents of American shippers in Liverpool. There were about a hundred merchants in that port, in addition to persons engaged in brokerage, and about ten of them handled three-quarters of the cotton imports. The next step was with the spinner. He instructed his broker either to buy the grade of cotton he required or to obtain samples from which he could make his selection. In 1947 the functions of these brokers and merchants, which had already been greatly reduced because of the war, were transferred to an officially appointed Raw Cotton Commission. This body operated as a monopoly for buying the raw cotton and supplying the spinners until, in 1954, it was abolished and the Liverpool market was reopened.

From the spinner the cotton passes as yarn, often through a yarn agent, to the weaver or manufacturer. The manufacturer usually works to the orders of a Manchester piece-goods merchant (or merchant converter) who, having obtained the cloth, sends it out to various firms of finishers for bleaching, dyeing and packing. These finishing firms work on commission, and so the property in the cloth remains during these processes with the merchant. Finally, the merchant arranges for the sale of the goods at home or abroad. Risks caused by fluctuations in the price of raw cotton from the time a consignment comes into the possession of the import merchant used to be insured against by "hedging." The Liverpool merchant, for example, protected himself against a fall in the price of the cotton which he had purchased by selling "futures" to an equivalent amount on the Liverpool cotton market, and he re-purchased these futures when he sold his cotton. The result was that the trade was able to throw on the market risks of price changes which would otherwise

have been a serious element in costs. The spinner and manufacturer also "hedged," if the conditions under which they traded made it desirable. With the disappearance of the Liverpool cotton market these dealings in futures came to an end (although the Cotton Control instituted a "cover" scheme to replace them), and it seems that, in spite of the resumption of futures trading in 1954, satisfactory hedging facilities have not yet been restored. The main divisions of the industry are, then, (1) the Liverpool merchants and brokers; (2) the spinners; (3) the yarn merchants and brokers; (4) the weavers or manufacturers; (5) the finishing trades; and (6) the piece-goods merchants, or merchant-converters.

It is still usual for a firm to confine itself to one of these groups. Indeed the typical producer limits his activities more narrowly. Within the spinning section there are two main subdivisions. These consist of spinners producing coarse and medium counts mainly from American-type cotton, and those producing fine counts mainly from Egyptian-type cotton.¹ In recent years another subdivision has become important, namely that concerned with spun rayon yarn, although by no means all this type is turned out by specialists. A smaller section deals with sewing thread. Within each of the main subdivisions there is still further specialization. Most firms confine themselves to a narrow range of counts or to special types of yarn. In the weaving section the same feature may be found, though in a modified degree, and firms concentrate largely on special classes of piece-goods. The finishing section includes specialists engaged in bleaching, mercerizing, dyeing, sizing, calico printing and proofing; while among the Manchester merchants there is specialization both according to trading methods and according to markets. Some merchants buy only after they have received an order; others make speculative purchases in anticipation of the requirements of foreign customers.

Specialization of this kind was appropriate to a large industry faced with problems such as those that confronted the cotton trade in a time of rapidly expanding demand. When the industry was small, specialization was less usual. For example, up to about 1820 the

¹ In 1937 44 per cent of Lancashire's raw cotton supply came from the United States, 20 per cent from Egypt, 12 per cent from India and Burma, 5 per cent from the Sudan and 19 per cent from other countries. During the twenty-five years before 1937 the proportion supplied by the United States fell steeply; in 1912 that country's share was 85 per cent. Since the Second World War the United States' share has further diminished; between 1950 and 1954 it was only 28 per cent.

leading cotton manufacturers conducted their export trade through their own agents in the chief foreign markets. It was in the course of the expansion of exports during the nineteenth century that selling became separate from manufacturing, and that a distinct class of merchant, in many cases recruited from the former foreign agents of the manufacturers, made its appearance.¹ Again, it seems that from 1820 to 1840 the typical mill was engaged in both spinning and weaving. After 1840, however, the separation of these processes began, as a result of "the multiplicity of finished products and the different technique demanded for maximum efficiency in spinning and weaving firms."² Yet, even in 1884, about 50 per cent of the employment in spinning and weaving was afforded by firms engaged in both processes. This proportion declined to 30 per cent by 1911.³ The high degree of horizontal specialization on the producing side of the cotton industry was therefore a creation of the thirty or forty years before the First World War.

The growth of the division between the main productive processes is to be attributed to the economies which, in a strongly localized industry, a producer who confines himself to one process is able to secure. These include both the "internal economies" that attend this type of specialization, and also those "external economies" which arise from the proximity of subsidiary industries and marketing facilities. In spinning, moreover, efficiency demands concentration upon a narrow range of standardized counts and also a large-scale organization. In weaving, on the other hand, the variety of products is greater than in spinning. Each type of fabric requires the use of different kinds of yarn which may be bought from a number of spinners, and the small weaving firm can operate successfully in the manufacture of many classes of products. Further, since the spinner produces a more standardized product than the weaver, commercial ability probably counts for more in the case of the latter, and so these two branches attract men of different types. The separation is also influenced by the existence of yarn export trade and by the demand for yarn from the sewing thread and hosiery industries; for this means that there is much spinning plant which does not have to be balanced by weaving plant. During the last thirty years the use of filament rayon yarns by weavers has also

¹ Cf. W. J. Ashley, *British Industries*, p. 81.

² J. Jewkes, *loc. cit.*, p. 96.

³ S. J. Chapman and T. S. Ashton, "The Size of Businesses mainly in the Textile Industries" in the *Journal of the Royal Statistical Society*, April 1914.

had an effect. In the finishing trades, technical problems are entirely different from those of the main branches and large plants are needed for economical production. For this reason, finishing firms are usually independent of other sections of the trade.

These general statements may be illustrated by statistics. The Cotton Industry Working Party reported that in 1946 there were 253 separate firms or groups of firms engaged in spinning, apart from a considerable number who were concerned only with waste spinning. Of these firms, 131 specialized in spinning and they had nearly half the total number of (spinning) spindles. About a third of the total (spinning) spindles were owned by 53 firms which combined spinning and doubling, and these firms owned half the doubling spindles.¹ There were 109 firms that occupied themselves with doubling only, and these had about a third of the total doubling spindles. On the weaving side, there were 1,062 firms, of which 922 specialized in weaving and owned three-quarters of the total number of looms. Thus, while spinning and doubling were frequently associated in the same firm, less than a fifth of the (spinning) spindles and less than a quarter of the looms were owned by firms that both spin and weave.² With the contraction of the industry since then, the concentration of ownership has increased, and by the middle fifties more than two-thirds of the spinning spindles were owned by 30 firms and two-fifths by 5.³ At the same time, the traditional horizontal specialization has been modified, as we shall see presently. The spinning mill itself varies greatly in size—from less than 30,000 spindles to 200,000 or more—and in 1940 more than two-thirds of the spindles were in mills with 90,000 or over. The doubling mill, on the other hand, like the doubling firm, is usually small (14,000 spindles is the average size), and this is true of mills engaged in waste spinning.

In the weaving or manufacturing section the typical firm has always been much smaller than the spinning firm. In 1956, 210 firms out of a total of 744 had fewer than 100 looms each, and although there were some very large firms with 2,000 looms or over, these together owned only a quarter of the whole loomage. In general the smaller sheds concern themselves with fabrics of a different type

¹ "Doubling" means twisting together several strands of yarn into a single thread.

² *Working Party Report on Cotton*, p. 37.

³ The spindleage is given in mule equivalents, i.e. 1 ring spindle = $1\frac{1}{2}$ mule spindles. In 1955 there were 14.5 million mule spindles and 10.8 million ring spindles. In addition, there were 800,000 waste spinning spindles and 2.8 million doubling spindles.

from those of the large sheds. In the past the small scale under which weaving could be successfully carried on provided opportunities for the operatives to rise to the ranks of the employers. A weaver, starting in a small way, could rent power and shop-room in a shed shared by several firms of the same type, obtain looms and yarn on credit, and manufacture on commission for a merchant. In 1940 there were sixty-one sheds with 69,000 looms in which weavers of this kind were operating.

In the finishing section of the industry the size of the firm and of the factories they own is large, and much of this section is in the hands of great combines. Even here there are numerous small firms with fewer than 100 operatives; but in 1939 these, in the aggregate, employed only about 12 per cent of the total number of workers in finishing.¹

The piece-goods merchants, or merchant-converters, who, as we have seen, occupy a key position in the industry, differ from one another in the size of their business no less than in its character. In 1940 their number was 1,764; but a substantial part both of the home and of the export trade was done by a very few of them. For instance, in 1940, nearly four-fifths of the total trade (in volume) was handled by 488 firms and two-fifths of it by only 53 firms.²

This separation of functions corresponds to the geographical specialization of the trade. Not only is the cotton industry as a whole strongly localized in East Lancashire and North Cheshire, but the different sections of it are associated with particular towns and districts.³ We have already seen that Liverpool handles the raw material, while Manchester distributes the finished products. On the production side there is a broad division between the north-east section of the cotton area which is concerned mainly with weaving, and the south-east part which is primarily a spinning area. Within each of the two main regions there is further specialization. Bolton

¹ *Working Party Report on Cotton*, pp. 42-3.

² *Ibid.*, p. 45. By 1955 the position had not significantly altered. There were then about 1,800 converters, of whom 400 handled five-sixths of the trade.

³ The localization has become rather less strongly marked during recent decades. For instance, Lancashire and Cheshire in 1951 had 80 per cent of the numbers engaged in the U.K. cotton industry compared with 88 per cent in 1931. The change occurred largely because of the development, with government encouragement, of the cotton industry in Scotland and Northern Ireland. Furthermore, as a result of the operation of the Distribution of Industry Act (1945), mills have been built in parts of Lancashire where formerly the cotton industry was not carried on. The tendency towards vertical integration has reduced the value of a location in the traditional centres since vertical firms are less dependent upon the marketing facilities offered by those centres.

and the area in the immediate vicinity of Manchester concentrate upon the finer counts; Oldham and Rochdale spin mainly medium and coarse yarns; the Stockport district is chiefly engaged in "doubling"; and waste spinning is largely done in Haslingden and Rochdale. In the weaving area Blackburn and Burnley produce plain cloths; Preston concentrates on fine shirtings, sheetings and fancy cloths, Nelson and Colne on apparel fabrics, including coloured woven cloths, and Nelson, Blackburn and Preston on rayon and mixture cloths. The finishing trades are fairly widely distributed in East Lancashire, but there is some concentration of them in the central part of the cotton area. It is difficult to account for the present location of the various branches of the trade, although an interesting explanation has been proposed.¹

The cotton industry did not entirely escape the tendency towards combination that was to be observed in many British trades during the last decade of the nineteenth century. This movement, however, was largely confined to special branches of the industry. Powerful close-combines were formed in the fine spinning, the sewing thread, and the finishing trades; but the weaving branch and those spinners who catered for the bulk trade were scarcely affected. Among the finishers, competition was further limited by the formation of several strong price-fixing associations in which the close-combines took part, and these associations were able to exercise monopolistic control over charges for dyeing, printing and bleaching. During the boom after the First World War the combination movement extended to the spinning branch, and two great combines were formed, the Amalgamated Cotton Mills Trust and Crosses and Winkworth Consolidated Mills. Neither of these combines was vertical in character, and although one or two combinations occurred at that time of firms in several stages of the industry, they covered only a small part of the productive capacity. Among merchants in the early inter-war period price competition remained as intense as ever. Thus the cotton industry faced its troubles with certain sections, such as the fine spinners, the sewing thread manufacturers and the finishers, dominated by combines and price-fixing agreements, though the main branches were still highly competitive.

To the mind of the commercial magnate or of the economist before 1914 there was something deeply satisfying in the organization of a great industry which had grown up without conscious plan and without any form of centralized control. The success of this

¹ See J. Jewkes, *loc. cit.*, *passim*.

organization provided a beautiful illustration of the way in which economic forces might be relied on to maintain equilibrium in the most complicated industrial structure. When the economist regarded Lancashire he might feel that there was, after all, some justification for Adam Smith's belief in an "invisible hand" which provided for the emergence of a common benefit from the conflict of the unco-ordinated wills of self-interested entrepreneurs. "Trusting almost exclusively to its automatic organization, the British cotton industry has surpassed all its rivals in size and in efficiency," said Marshall.¹ A Lancashire business man himself declared: "This mode of organization is absolutely essential to the success of the British cotton industry, because of the great diversity of taste, of climate, and of buying power of the numerous races and peoples in the world-wide markets to which British cotton manufactures are sent."² A Government Committee declared itself "much impressed by the degree of localization and of specialization in the cotton trade and by the highly developed systems of production and marketing, which we consider have largely contributed to the strong position of the industry."³ The eulogies bestowed upon this individualistic organization while the industry was still enjoying a triumphant progress were balanced by condemnation of it during the period of decline. An authority on the cotton industry spoke of "three thousand unco-ordinated small units . . . all without cohesion, without nucleus, loose, higgledy-piggledy, rushing hither and thither, jostling, chasing, fighting, the whole curious phenomenon involving an enormous wastage of money, energy, time and power."⁴ The Economic Advisory Council stated: "The number of separate concerns in the spinning, manufacturing and merchanting sections of the industry is, in present conditions, largely responsible for its helplessness in the cheap bulk trade."⁵ From these opinions it might be inferred either that the importance of organization was greatly exaggerated both by those who condemned and by those who admired the form it had assumed in the cotton industry, or that the conditions of international competition changed so fundamentally after 1913 that an industrial structure which was then admirable later became

¹ *Industry and Trade*, pp. 602-3.

² E. Helm in Ashley's *British Industries*, p. 80.

³ Departmental Committee on the Textile Trades, *Report*, 1918 (Cmd. 9070), p. 49.

⁴ B. and H. Ellinger, "Japanese Competition in the Cotton Trade" in the *Journal of the Royal Statistical Society*, p. 211.

⁵ *Report on the Cotton Trade*, p. 19.

inappropriate. To-day, no one would hold that the inter-war decline could have been prevented by reorganization, for that decline was brought about mainly by a complex of external factors. Whether it could have been arrested at any stage by action that lay within the powers of the members of the industry is more debatable. That question, and the whole controversy that raged over the remedies prescribed for the industry in the midst of its inter-war troubles can best be considered in conjunction with later criticisms and after a brief description has been given of the policy followed in the twenties and thirties.

V

Experiments in Reorganization

With the onset of the depression in 1920 the industry had resorted to its traditional policy in the face of a fall in demand, viz. organized short time. The chief employers' organization, the Federation of Master Cotton Spinners, recommended that spinners should keep their plants idle during part of each week, and this policy was followed throughout the greater part of the twenties. Wages were reduced, and many operatives were in fact maintained partly by the State, for it became the practice to employ them in alternate weeks so that they could draw unemployment benefit in the intervals of work. The policy of organized short time was well adapted to deal with temporary depressions, but it was quite unsuitable for meeting a permanent decline in demand brought about by foreign competition, since it increased unit costs. In any case, the association was unable to enforce its policy. "Disloyal" mills benefited at the expense of the "loyal" majority, and this "weak selling" brought down prices to levels which sometimes did not cover direct running costs. Various efforts to prevent weak selling were made, but all ended in failure. In 1927 a cartel, the American Cotton Yarn Association, was formed for the purpose of grading yarns, fixing minimum prices and regulating output. The capital of this Association was subscribed by the spinners who contributed in proportion to the number of spindles owned by them, and a part of it was uncalled. The cartel's rules provided that any member who violated the agreements should be liable to pay up the uncalled part of his shares and to expulsion. Lists of minimum prices were drawn up and output was controlled by a system of transferable quotas. It was hoped that the weaker mills

would sell their quotas to the stronger, and that this would lead to a concentration of output on the more efficient units. But this effort also failed, because firms outside the Association undercut the minimum prices and so obtained a disproportionate share of the trade.

The reasons for the breakdown of these price-fixing efforts are easy to understand. In the first place, the large number of producers and, no doubt, the horizontal specialization characteristic of the industry threw obstacles in the way of concerted policy. In the second place, the troubles of the industry arose from the loss of export markets through the cheaper production of its overseas rivals, and the raising of prices was hardly calculated to improve the competitive position of the British producers. It might have been expected that the financial losses sustained by the industry would have led to a rapid reduction of capacity. In fact, however, this process occurred too slowly to permit the elimination of the large amount of surplus capacity that had appeared. To some extent this was attributable to the financial structure of the industry, especially the spinning section. During the boom of 1919 and 1920 many spinning firms were recapitalized or converted into public companies, for their owners were anxious to capitalize the increased earning capacity of their property. The procedure was for money to be borrowed in the form of loans at call on the security of the new, unpaid share capital. This had been the usual method of capitalization in Lancashire, and before 1913 it no doubt suited local conditions. The practice led to serious difficulties, however, once the post-war slump had begun, and it probably helped to delay the elimination of surplus capacity. For, when the mills got into difficulties and became unable either to repay the bank loans or even to meet the interest charges, the decision whether to continue or to close passed to the creditors. These were for many years reluctant to enforce their claims in the hope that conditions would improve, while in other cases companies were able to stave off bankruptcy by calling up their unpaid capital. Thus, the financial circumstances of the industry created a situation which made reorganization either by agreement among the mill-owners or by the bankruptcy of the weaker, slow to come about.

As it was gradually realized that the industry must accommodate itself to a permanent shrinkage in demand, policy entered upon a new phase. It was now argued that Lancashire must look for salvation to large-scale amalgamations which would be accompanied by the removal of surplus capacity and would permit the industry to reap the economies of specialization, bulk buying and bulk selling.

In December 1928 the Joint Committee of Cotton Trade Organizations, which had been formed to co-ordinate the activities of the different sections, endorsed this policy, and a number of co-operative ventures and combinations made their appearance. One of these took the form of a vertical organization designed to undertake the bulk production and marketing of standard cloths for China; but this Eastern Textile Association Limited, as it was called, came to grief because of the collapse in the demand for the lower grade cloths during the early years of the Great Depression. It was useless to re-organize the industry so that it might cater for a mass demand, when that demand had virtually disappeared. Among the combinations that were formed during this time, by far the most important was the Lancashire Cotton Corporation, registered in January 1929. The Corporation set itself the task of acquiring some ten million spindles—about one-fifth of the existing capacity in the spinning section—and about 30,000 looms. The obligations issued in return for each mill that was acquired were supposed to be based on the current value of its assets, and so, before any amalgamation could occur, a writing-off of capital and a scaling-down of debts were necessary. Pressure was brought to bear on the creditor banks by the Bankers Industrial Development Company, formed at this time on the initiative of the Bank of England to help in the financing of rationalization schemes. Unfortunately the Corporation began its operations during the World Depression, and although it carried out its programme of amalgamations and scrapping, it could do little to foster mass-production and large-scale marketing for reasons already discussed. Moreover, under pressure from the banks anxious to dispose of bad securities, the Corporation saddled itself with many mills of dubious value, and in the early days there were mistakes of policy which weakened its position. It acquired over 9 million spindles which it reduced by 1939 to 4½ million.

Rationalization certainly had an effect in reducing capacity. In 1920 Lancashire had had nearly 59 million spindles, and these had fallen by only 3 million in 1929. After then the reduction was more rapid, and by the end of 1934 the total number of spindles had been reduced to 44 million. But even so the industry still had 13½ million spindles more than were necessary for full-time running; of these, 4 million were in the fine spinning (Egyptian) section and 9½ million in the coarse and medium spinning (American) section.¹ Other

¹ Sir T. D. Barlow, "Surplus Capacity in the Lancashire Cotton Industry" in *The Manchester School*, Vol. VI, No. 1 (1935).

branches of the industry, including the weavers and finishers, had a similar redundancy of capacity. The Joint Committee of Cotton Trade Organizations now came forward with another proposal for eliminating this excess. It was based on a scheme which had been canvassed without result in 1931-2. A Surplus Spindles Board was to be formed to buy and sterilize 10 million spindles out of the 13½ million regarded as surplus. A capital of £2 million was required, and this was to be raised by a bond issue on which the annual charges would be met by a levy imposed on the running machinery. A sufficient majority in favour of this scheme was obtained and legislative force was given to it by an Act of Parliament in 1936. By September 1939 the Spindles Board had acquired and had scrapped, or was about to scrap, 6 million spindles, and so on the eve of the Second World War the total spinning capacity had been reduced to about 39½ million spindles.¹ This was accompanied by the closing of many mills; between September 1936 and March 1939 the number of operating mills declined from 579 to 501. No similar scheme was tried for weaving, and in that section the reduction in the number of looms from 792,000 in 1924 to 495,000 in 1938 had been brought about by attrition. The number that remained was still far in excess of needs. In the finishing sections much capacity was closed down by the three great combines.

A final step in this long series of efforts to cope with the progressive decline in trade was taken in 1939 when the Cotton Industry (Reorganization) Act was passed. This was the culmination of a movement supported by the majority of mill-owners and workers. Its purpose was to deal drastically with weak selling, and to this end it established machinery for fixing compulsory minimum prices. The outbreak of the war prevented this Act from being put into force, but its significance for an industry which had for so long been the home of competitive individualism needs no emphasis.

The main preoccupation of the cotton industry during the inter-war period was with the surplus capacity and the unprofitable trade that attended it. But the removal of surplus capacity was of value only in opening the way to improvements in methods and organization. To establish a profitable level of prices by eliminating cut-throat competition could obviously not in itself lead to a reversal of the prevailing trends. Indeed, the guarantee of minimum prices, as proposed by the 1939 Act, might be expected to weaken any

¹ *Annual Reports of Spindles Board* (Cmd. 5873 of 1938 and Cmd 6157 of 1940).

incentive to reduce costs. Redundancy schemes in any industry can only be justified if they make cost-reducing improvements possible. The part that such schemes can play in bringing about such improvements has been discussed elsewhere,¹ and the question to which we must now turn concerns the character of the improvements that were proposed during the inter-war period. They covered both organization and equipment. In regard to the former, many critics were confident that a major source of weakness was to be found in the sectional organization of the industry. Although for reasons already given, the integration of spinning and weaving had little to recommend it, it was believed that a closer association of the manufacturers and the merchants was urgently necessary. In the words of the Economic Advisory Council: "To hold or regain the trade in cheap staple lines, one of the most urgently needed reforms is the linking of marketing with production. To produce cheaply, it is necessary to produce in bulk. To produce in bulk, a rational policy of marketing must be joined to production, and no successful policy of mass production can be conceived or executed without the market organization appropriate to that policy."² In the existing conditions, it was said, costs were high because producers had to deal with a multiplicity of small orders from many merchanting houses. In order to preserve his own good-will, the merchant was inclined to introduce deliberately slight variations in the specifications of the cloth ordered. This practice, by making competition less perfect, kept alive many firms that would have otherwise have dropped out, and it prevented the realization of the economies that might have followed a concentration of output and mass marketing. One of the arguments in favour of redundancy schemes was, of course, that they would eliminate some of these market imperfections.

The argument was supported by appeal to foreign example. The Cotton Mission which was sent to investigate market conditions in the Far East reported that if Japanese competition was to be successfully met, the individual trader would have to be replaced by large selling organizations capable of keeping stocks of bulk lines on the spot and of providing orders for mass-produced goods.³ The Japan-

¹ See "An Aspect of Industrial Reorganization" in the *Economic Journal*, June-September, 1945.

² Economic Advisory Council, *Report on the Cotton Trade*, p. 19.

³ Department of Overseas Trade, *Report of the British Economic Mission to the Far East* (1931). Cf. also, A. S. Pearce, *The Cotton Industry of China and Japan*, especially pp. 25-43, 141 *et seq.*; and B. and H. Ellinger, *loc. cit.*, pp. 198 *et seq.*

ese industry was alleged to be organized in this way. There was a close relationship in Japan (so it was said) between manufacturing and marketing, while among the producers output was far more highly concentrated than in Lancashire, and spinning and weaving were integrated. This organization permitted the Japanese mills to buy in bulk, to obtain the economies of specialization and standardization, and to market cheaply. There was no division of interest between merchant, spinner and manufacturer, and so a common policy could be followed. The moral for Lancashire was clear.

These arguments were repeated during and after the Second World War. The Trade Unions in 1943 declared that the recovery of the export trade required the "elimination of redundancy among merchants," and closer co-operation among merchants, finishers and manufacturers.¹ The Cotton Board Committee in 1944 reached the conclusion that "it is beyond doubt that there are too many units" in the exporting business.² The Cotton Textile Mission to the United States (the Platt Mission), apart from its criticism of the equipment of British mills, spoke of the necessity for standardization and specialization in British production "to allow the introduction of uninterrupted bulk production methods," and it concluded that this would mean a closer association of the different sections of the industry, particularly the manufacturers and distributors.³ In general, the horizontal organization of the British industry was contrasted unfavourably with the vertical organization of the American industry. Finally, the Working Party on the Cotton Industry (1946)—or a part of it—reported in favour of creating "an effective organization for the industry as a whole" to cover both production and distribution, the reduction of the number of separate units in spinning by amalgamation and a "closer link-up" between production and distribution. This was to be secured by the establishment of a new central marketing company with the functions of securing "bulk and continuous running" and of acting as "a medium for the expansion of that vertical co-operation which all the evidence of our inquiries has shown to be so desirable."⁴

These criticisms, however, did not pass unchallenged. It was not denied that inefficiency had crept into the Lancashire industry

¹ United Textile Factory Workers' Association, *Report of Legislative Council on the Cotton Industry* (September 1943).

² *Report of the Cotton Board Committee to Enquire into Post-war Problems* (1944), p. 7.

³ *Report of Cotton Textile Mission to the United States* (1944), p. 40.

⁴ *Report of Working Party on Cotton*, pp. 160, 164, 175, 187-8.

because of its inability to adjust itself to the contraction of demand; but that reorganization for mass-production was the appropriate remedy was held to be more doubtful. In the first place, the lessons to be learned from foreign example were ambiguous. It is true that the American industry, where productivity was greater than in Lancashire, had a vertical organization for the most part and followed a policy of bulk production; but it was from Japan and not from the United States that Lancashire had encountered her chief competition in international trade. Now, an important section of the Japanese cotton industry was certainly organized vertically. In that section large spinning-weaving mills were usual, and some of the companies that owned them were associated financially with the great merchanting concerns which both imported raw cotton and exported the fabrics. That section, however, confined its output almost exclusively to a few standardized commodities, namely cheap shirtings and sheetings. The rest of the industry was organized on lines much like those of Lancashire, and manufacturing was conducted in independent weaving sheds, some of which were very small. Whereas in the twenties the greater part of the Japanese output and exports came from the vertically integrated section of the industry, by the middle thirties this had ceased to be true. By then the cheap staple lines were meeting with increased competition in the foreign markets, and the Japanese were therefore finding that their main advantages lay in producing higher quality fancy goods which were turned out by the horizontally organized section of their industry. Throughout the thirties up to the outbreak of the Sino-Japanese War in 1937, a steadily increasing proportion of the output and exports came from this section.¹ Thus at a time when Lancashire was being urged to transform itself into a vertically organized industry in order to meet Japanese competition, the Japanese were finding it necessary to develop an organization similar to that of the British in order to hold their markets.

The criticism that there was redundancy in the merchanting section was also shown to have slender foundations. An investigation of the facts disclosed that in 1940 large merchants, who made up 19 per cent of the total number, were responsible for 87 per cent of the trade. Further, it was demonstrated that the large number of merchants was the result of the conjunction of the wide range of markets served by Lancashire and the extreme specialization by

¹ Cf. G. C. Allen, "Japanese Industry, etc.," in E. B. Schumpeter (Ed.), *op. cit.*, pp. 568-86; and T. Uyeda, *The Small Industries of Japan*, Chap. II.

merchants on particular markets.¹ Unless market specialization is to be condemned for some reason not yet put forward, and unless it is believed that the elimination of those merchants who were neither large nor market specialists and who were together responsible for only a very small proportion of the trade, would have any significant effect on the volume of exports, then the case for organized effort to get rid of the alleged redundancy falls to the ground.

The controversy came to a head in the Cotton Working Party. Although the main interest in their Report lies in the matters on which members disagreed, certain of the agreed recommendations provide a useful commentary both on the trend of opinion and also on the change of circumstances in this industry after 1939. For instance, the introduction of a system of statutorily enforceable minimum prices which had been accepted as desirable by the Government before the war, and which had been recommended by the Cotton Board Committee on Post-war Problems in 1944, was rejected. It is equally significant, however, that the Working Party as a whole agreed about the necessity for "concerted action" and the strengthening of central authority in the industry, and that it also favoured a close relationship between Government and industry in policy-making. Disagreement turned mainly on the field of concerted action and on the responsibilities to be assumed by the Government. One group, headed by the Chairman, advocated what can be regarded as conventional measures of rationalization. First, it recommended a scheme to remove surplus capacity in the spinning industry, and it argued that without a scheme there would be a scramble for labour and a spreading of output among the mills so that none would be able to operate near to capacity. The shortage of labour and the difficulty of rebuilding the labour force after the war-time contraction gave additional force to this recommendation. In the second place, this section of the Working Party proposed that groupings or amalgamations of spinning firms should be promoted; in this way there would be created units large enough to handle plans of re-equipment and few enough to permit co-operation in a concerted policy. Thirdly, it suggested that a fund should be collected from a levy on spinners which would be used to help firms to carry out the approved measures of re-equipment. The levy was to be financed by a rise in the price of yarn which might be offset by reductions in

¹ H. Kenyon, "The Shape and Size of the Export Merchanting Section of the Cotton Industry" in the *Transactions of the Manchester Statistical Society*, 1944.

wholesale and retail margins. A Central Council for the industry was to take the initiative in promoting groupings and in working out the general programme of re-equipment and reorganization.

The rest of the Working Party objected to the redundancy scheme chiefly on the ground that the estimate of the future supply of labour was pessimistic; but their main disagreement with their colleagues turned on the proposals for re-equipment and amalgamation. They argued that there was no evidence to suggest that the creation of large combines would yield economies, although this did not dispose of the contention that groupings of firms would have a useful part to play in the process of reorganization, including the removal of redundancy. On the proposals for re-equipment, the dissentients did not dispute the need for improved machinery, but they claimed that because of the immense diversity of conditions among the various firms, a policy of re-equipment must be highly selective. The suggested levy and the centralized administration of re-equipment would "disturb and delay the selective and discriminating process." In other words, while conditions might be created to stimulate re-equipment (as by increased depreciation allowances for income tax purposes, or Government help in raising capital cheaply), detailed decisions should be left to individual firms. In general, it would seem that while pre-war experience suggests that there is much to be said for a redundancy scheme to remove surplus equipment quickly, the dissentients had the best of the argument so far as the re-equipment levy and its administration were concerned.

On the weaving side, the proposals of the Working Party were tentative, partly because it was expected that redundancy in that section was likely to be eliminated, largely through the re-spacing and throwing out of looms consequent upon the recent recommendations of a committee appointed by the Chief Inspector of Factories. This was in fact the process by which about a quarter of the equipment was removed.¹ Re-equipment in that section, however, turned mainly on the question of the advisability of replacing Lancashire by automatic looms. Apart from the fact that the economies to be realized from the use of automatic looms were uncertain in view of the working conditions in Lancashire and of the type of goods which Lancashire mainly supplies, the capacity of the textile machinery trade for

¹ In the spring of 1958, as a consequence of the deepening depression in the weaving section, a company (Weaving Reorganization Ltd.) was formed by the manufacturers with the functions of buying up and scrapping surplus weaving equipment.

building automatics was so small as to remove any proposal for their general adoption from the sphere of practical possibilities for many years to come.

The Government responded to the Working Party's Report by reconstituting the Cotton Board as the central co-ordinating body for the industry and by introducing a subsidy for re-equipment in the spinning section to the extent of a quarter of the cost. This subsidy was granted on certain conditions. The most important of these was that it should be confined to concerns, or groups of concerns, with not less than 500,000 spindles. It was expected that this provision would lead to the concentration of production on fewer mills modernized in equipment and organized for double-shift working. The scheme certainly encouraged the financial grouping of mills, but the general conclusion is that it failed to accelerate re-equipment, although it may have concentrated investment on modernizing a small number of mills instead of on "patching" a larger section of the industry.¹

The scheme was designed to promote horizontal combination within the spinning section, but other influences during the immediate post-war period led to vertical integration also. As generally happens in periods of shortage, producers in a particular stage of production were induced to acquire control of their suppliers in order to ensure deliveries, and the attempts of several sections to operate price-fixing arrangements gave further encouragement. After 1951 re-organization went forward rapidly as a response of firms to the contraction of demand that followed the onset of the textile recession. Among manufacturers and converters there was a general tendency towards reduced specialization, both in the type of cloths produced and also in the markets served. At the same time the closing down of a number of spinning mills and the reduction in the number of independent units by horizontal amalgamation, led to several spinning-weaving combinations. Further, spinners joined with doublers, and converters linked themselves with weavers. In a few instances integration was carried forward into the making-up stage (a movement that was associated with the increasing mechanization of clothing manufacture), and even into the retailing of the finished products. Some of these combinations were designed to realize technical and marketing economies. Others arose out of the financial circumstances of the industry. The heavy taxation on distributed profits in the post-war period, in this as in other trades, brought about a

¹ R. Robson, *op. cit.*, p. 219.

situation in which the market value of the shares was well below the earning power of the companies' assets. So, an opportunity was given for purchasers to acquire and for existing owners to sell mills on terms exceptionally favourable to both.¹ The integration movement did not affect the finishing trades to the same extent, although in printing, a great concern, which is responsible for half the output of printed cloth, has long possessed "an important merchanting organization as well as spinning and weaving mills."²

The result of these movements was a reduction in the importance of the specialist producer in all stages of the industry. By the middle fifties vertically organized *firms*, which were not, of course, necessarily operating vertically organized *mills*, had much increased their share of the trade. Before the war the proportion of looms associated with the spinning interests was 23 per cent; by 1956 it had risen to 32 per cent.³ The proportion of spindles associated with the weaving interest in the same period increased from 24 per cent to 37 per cent. The integrated section of the industry in 1956 was absolutely larger than before the war, whereas the non-integrated section had declined by one-third in weaving and two-thirds in spinning. The progress of vertical integration is also shown by the fact that nearly two-thirds of the looms were controlled by firms engaged in converting; before the war the proportion was about two-fifths.⁴

So far the changes in the industry's machinery, though considerable, have been less revolutionary. Investment in new equipment immediately after the war was heavy, for by 1945 much of the plant needed replacement, and new machines were necessary to meet changes in the types of product in demand. The proportion of ring spindles has increased at the expense of mules,⁵ and automatic looms now account for 13 per cent of the total compared with only 3 per cent before the war. Conditions have become more favourable for the operation of automatics because of the agreements between the employers and the trade unions for double-shift working, but the British industry still lags far behind foreign industries in the extent of their use. Many detailed technical improvements have been introduced especially in the machinery preparatory to spinning and in

¹ This is the basis of the "take-over bid" procedure. The purchasers acquired assets cheaply and the sellers obtained an untaxed capital gain.

² The Monopolies and Restrictive Practices Commission, *Report on the Process of Calico Printing*, p. 38.

³ The proportion would be higher if looms engaged on weaving filament rayon were excluded from the total.

⁴ R. Robson, *op. cit.*, pp. 121, 125.

⁵ 41 per cent in 1954 compared with 28 per cent in 1937.

finishing works. The industry has also been active, in association with the famous Shirley Institute, in devising new types of fabric.

The shortage of labour in the cotton industry immediately after the war naturally focused attention on all types of labour-saving devices. It was realized that higher productivity could be obtained not only by adding to the quantity of capital but also by reorganization which might enable firms to use the existing supply of factors more efficiently. Efforts were, therefore, directed towards that purpose. Before the war an enquiry into wages in cotton spinning had shown that the introduction of more efficient methods was often impeded by the obsolete system of wages which stereotyped methods of working and inhibited the efficient use of labour.¹ Official inquiries conducted during and after the war into both spinning and weaving supported this conclusion.² It is not possible here to review in detail the criticism of the existing wage system or the proposals for substituting for the old uniform list of piece-prices a system which relates earnings more closely to productivity and which permits the introduction of more rational methods of using labour. Experiments so far conducted suggest that "re-deployment," together with a new wage system, would substantially increase productivity and average earnings, without imposing any greater strain on the operative. The best known of these experiments was that conducted in March 1948 in the Musgrave Mill at Bolton. This was initiated by the Cotton Board, in agreement with the employers' association and the trade unions, and a firm of industrial consultants conducted the experiment. The details of the reorganization are highly technical and cannot be discussed here. It may be said, however, that there was a rearrangement of duties among the workers so as to secure a greater degree of specialization in their operations, and there was also an alteration in the layout of the machines. To win the co-operation of the workers in the experiment an incentive bonus scheme was introduced. The results were striking. Output per man-hour increased by 39 per cent; weekly wages increased by 30 per cent; and labour cost per pound of yarn fell by 10 per cent.

In the weaving branch the Cotton Manufacturing Commission

¹ J. Jewkes and E. M. Gray, *Wages and Labour in the Lancashire Cotton-spinning Industry*, *passim*.

² See *Report of Commission set up to Review Wages Arrangements and Methods of Organization of Work in the Cotton-Spinning Industry* (October 1945); *Reports of Cotton Manufacturing Commission* (February 1948 and March 1949); and Cotton Board, *Report on Labour Re-deployment in the Musgrave Mill Cardroom* (March 1948).

which was set up by the Government after the war, conducted similar experiments. In their report for 1949 the Commission described the results of these "re-deployment trials." The average results were an increase of 89 per cent in production per man-hour, a 43 per cent increase in earnings and a reduction in cost of nearly 22 per cent. The Commission concluded, as a result of its examination of weaving methods in Lancashire: "... unless re-deployment over a wide field is put into effect without further delay, then, as an exporting industry cotton and rayon manufacturing in Lancashire will have had its day. Adherence to traditional methods of weaving on ordinary looms means that costs of production are quite unnecessarily high," while "the general use of automatic looms lies years ahead."¹ The increase of efficiency in cotton manufacturing, therefore, depended mainly on the reorganization of work-places so as to provide for a better use of labour, and this change was only likely to come about if it were accompanied by the introduction of a new system of wages. An agreement in 1949 for the introduction of a system of payment based on work studies and known as the "Cotton Manufacturing Commission System" represented a step towards this goal. In spinning also there were agreements between local unions and employers of a similar kind. These were followed in 1956 by a general agreement which provided for double-shift working and the establishment of a wage structure more closely related than hitherto to the work done by the operative.

So far the effects of re-deployment on average productivity, though carried out by a large section of the industry, have been small. The Cotton Working Party has estimated that at the beginning of 1946 output per head in spinning was about 20 per cent less than in 1937, and a later study put the decline between 1938 and 1947 at 17 per cent.² This latter estimate brought in all employees and not merely those engaged on the machines, and part of the decline in productivity was attributed to the disproportionate rise in the number of ancillary workers, including those in the welfare departments. Another part of it was due to the reduction in the length of the normal working week, from 48 hours to 45 hours. After 1947 there was an improvement in productivity, but this was very slight, especially in spinning, and it could be accounted for by the increased use of staple fibre by the spinners (which makes less demand on labour in

¹ Cotton Manufacturing Commission, *Final Report of Inquiry into Wages Arrangements, etc.*, Part I, p. 15.

² D. C. Shaw, in the *Manchester School*, January 1950.

the preparatory processes than raw cotton) and on the weaving side by the rise in the proportion of automatic looms and the greater use of spun rayon. Changes in raw materials used and the kinds of yarn produced make exact calculations of productivity impossible; but these enquiries suggest that output per man-hour has certainly failed to rise sufficiently to offset the effects of more welfare and more leisure. Meanwhile, in the United States, Europe and Japan, productivity has substantially increased, and this is a reason for serious disquiet. The average figures of productivity, however, obscure a wide disparity in the experience of different mills. There is a group of progressive firms which have made considerable advances in productivity, but the industry, faced as it has been with a secular contraction of demand, contains other firms which have sought merely to operate their existing plants by traditional methods until they are forced to close. The presence of this latter group has reduced average productivity. Once these firms have ceased production, comparisons with other countries are likely to be more favourable. On the other hand, the contraction of the industry itself cannot be dissociated from a failure to modernize organization and equipment on the scale attempted by its rivals.

At this point, however, a word of warning is necessary. The statistical results of inquiries into productivity are helpful in focusing attention upon one of the chief constituents in costs; but, especially when comparisons between countries are in question, they must not be taken as accurate measures of efficiency. This point may be illustrated by reference to the report of the Platt Mission to the United States (1944). That report showed that for nearly every process, productivity in the American cotton spinning industry was far higher than in the Lancashire mills, and it advocated the widespread adoption of high drafting and other forms of modern spinning equipment as a necessary step towards improvement in this country.¹ The Mission was concerned, however, solely with *technical* efficiency. An economic comparison must take account also of relative factor prices and of the type of markets and goods for which each country possesses the greatest relative advantages. For instance, since labour is very expensive in the United States, it pays the spinners

¹ The conclusions of the Platt Mission in this respect were largely confirmed by the Productivity Team that visited the United States in 1949. For instance, on the average, for every 100 operatives needed in America to produce a given quantity of roving in cardroom processes, 263 were needed in England. See Anglo-American Council on Productivity, *Productivity Team's Report on Cotton-Spinning*.

there to use high-grade raw cotton and so to economize labour in the preparatory processes. In Great Britain, lower-grade and cheaper cotton can be used in the production of goods of high quality because relatively cheap labour is available for preparing the material for the spinning machines. The difference in practice between the two countries makes the comparison of productivity (physical output per man-hour or man-year) favourable to the United States; but there is nothing in this to show that the British practice is less *economically* efficient than the American. Similarly, since the benefits of automatic looms are realized chiefly in the manufacture of standardized fabrics, a country whose relative advantages lie chiefly in the production of specialities may well find their *general* adoption inexpedient.

In future the industry's attempts to regulate production and prices will have to conform to the requirements of post-war monopoly legislation. War-time measures, including the concentration of industry and price control, had considerably diminished the area of competition. On the abandonment of price control in the spinning and weaving sections in 1949, the Yarn Spinners' Association recommended that the fixed margins previously established by the price control authorities should be regarded as minima by their members. This arrangement met with difficulties after the onset of the slump in 1952, and if it is to continue in any form, it must be justified before the Court set up under the Restrictive Practices Act of 1956. In weaving, attempts to introduce minimum price schemes after 1949 failed, except in the rayon weaving branch. In finishing, where central regulation had a long history, the wartime concentration of production policy led to the closing of many works and to the compensation of the "closers" by the "runners" under pool and quota schemes. After the war the calico printers carried on a substantially similar arrangement by which each firm was annually allotted a percentage quantum of the turn-over of the trade and was also required to comply with the directions of the Calico Printers' Federation in regard to prices. In 1954, however, the scheme was condemned by the Monopolies and Restrictive Practices Commission and had to be given up.¹ Furthermore, several finishing branches had introduced redundancy schemes financed by levies on the several firms and this had brought about a reduction of capacity. The redundancy agreements contained provisions for restricting the use of

¹ Cf. The Monopolies and Restrictive Practices Commission, *Report on the Process of Calico Printing*, Chap 10.

closed plants and of water rights in order to prevent newcomers from entering the industry. These restrictions also were considered to be contrary to the public interest by the Commission when it reported on the calico-printing industry.

The government's anti-monopoly measures, as applied to the cotton industry, have been very sharply challenged in Lancashire. It has been argued by some critics that centralized regulation of prices and output, while open to attack as permanent measures, are justified in a period of contraction and reorganization. Whether this is so or not the cotton industry during the next few years is likely to face even keener competition than in the past from both Europe and Asia, and restrictive arrangements of the kind formerly practised will obviously be irrelevant to the task of meeting that competition.

PRODUCTION AND EQUIPMENT, 1937-57

Year	<i>Singles Yarn Output</i> ¹ (in million lb.)	<i>Output of Fabrics</i>		<i>Equipment</i>	
		<i>Cotton</i> (in million linear yards)	<i>Rayon and Mixtures</i> ² (in million linear yards)	<i>Spindles running</i> ³ <i>on single yarn</i> (in millions)	<i>Looms running</i> ⁴ (in thousands)
1937	1,375	3,640	482	39	419
1945	697	1,539	308	17	216
1946	781	1,628	354	20	224
1947	788	1,622	390	22	241
1948	944	1,898	499	25	272
1949	990	2,002	588	27	289
1950	1,053	2,123	707	28	305
1951	1,078	2,202	759	28	312
1952	771	1,691	601	21	250
1953	954	1,864	769	24	271
1954	997	1,994	781	25	281
1955	879	1,781	699	22	253
1956	849	1,612	702	21	229
1957	877	1,633	660	20	223

¹ Includes cotton waste yarn and spun rayon and mixture yarns.

² Including other synthetic fibres. The output for 1937 is in million square yards.

³ Mule equivalents. Covers number actually running on cotton, spun rayon and mixtures, excluding waste.

⁴ Looms actually running on cotton and/or rayon fabrics (monthly averages).

EXPORTS OF COTTON YARN AND PIECE-GOODS FROM THE UNITED KINGDOM¹

<i>Year</i>	<i>Yarn</i> ² (in million lb.)	<i>Piece-goods</i> ³ (in million sq. yds.)
1910-13 (annual ave.)	217	6,665
1924	163	4,445
1928	169	3,868
1929	167	3,672
1930	137	2,407
1931	134	1,716
1932	142	2,197
1933	135	2,031
1934	130	1,994
1935	142	1,949
1936	151	1,917
1937	159	1,922
1938	123	1,368
1946	19	516
1947	27	532
1948	58	760
1949	82	904
1950	71	822
1951	65	865
1952	36	711
1953	42	709
1954	40	637
1955	36	555
1956	37	480
1957	38	456

¹ The establishment of the Irish Free State as a separate customs area after April 1st, 1923, affects slightly the comparability of the figures for 1910-13 and the period after the First World War.

² In addition to these yarns, an annual average of 22.7 million lb. of finished thread was exported in 1910-13, 18.4 million lb. in 1927-9, 16.7 million lb. in 1935-7, 12.3 million lb. in 1947-9, and 10.5 million lb. in 1956-7. For rayon exports, see p. 293, *infra*.

³ Goods made of rayon and mixtures are not included in these figures, although they are produced by the cotton industry. For these, see p. 294, *infra*.

CHAPTER X

WOOLLEN AND WORSTED

I

The Organization of Production and Marketing

The wool textile industry is the oldest of the great manufacturing industries of this country. Whereas the cotton industry was of little importance until the last part of the eighteenth century, even in the Middle Ages England had been a leading centre of raw wool production, and on the basis of this supply of material a substantial manufacturing industry had developed, particularly in East Anglia and the West of England. By the sixteenth century a large foreign trade in woollen cloth had grown up. Until the early years of the nineteenth century woollen and worsted goods formed by far the largest item among the exports of British manufactured commodities, and the industry producing them surpassed all others in magnitude. With the introduction of the factory system the cotton trade drew ahead of its rival, which was much slower in adopting mechanical methods of production. This has been attributed to various causes, viz. the shortage of raw material before the importation of Australian supplies in the thirties, the conservatism of masters and men in an old-established industry and technical difficulties in manipulating the material on machines. Although worsted-spinning, to which machinery could be most easily applied, had gone into the mills by 1815, the industry as a whole did not become predominantly a factory trade until about 1860, and hand-loom weaving in the woollen section, where change was slowest, did not cease to be of substantial importance until the end of the century. The migration of the industry from its old centres in the West of England and East Anglia to Yorkshire took place during this period of changing organization. The influences at work appear to have been the superiority of the West Riding over other centres in its supply of water for "fulling" and for power, its coal resources, its plentiful supply of cheap labour and the conservatism of the older centres in the face of changing methods of production. The transformation of the wool-using trades, late as it was, accounts for the failure of

the labour force to increase after 1850. In spite of the rise in the quantity of raw material used, from 241 million pounds in 1850-4 to 846 million pounds in 1909-13,¹ numbers remained unchanged at about a quarter of a million throughout this period. According to the census of 1921 there were about 138,000 in the woollen and 121,000 in the worsted branch.²

During its earlier history the raw material for this trade was provided almost entirely from home resources; but in the eighteenth century, partly on account of a change in the quality of British wool which followed on the practice of breeding sheep for mutton, the finer wools came to be imported from Saxony. With the introduction of Australian wools after 1830 the proportion of the materials supplied from the home clip rapidly declined. This process was carried further after the middle of the century by an increase in the amount of recovered wool used by the industry. By the sixties the share of the raw material provided from overseas had become greater than the home production. In subsequent years the absolute amount, as well as the proportion of the home wool used, declined, partly because of a fall in the weight of the home clip and partly through a growth in the exports of British wool. In 1909-13 the retained production of home-grown wools amounted to only 11 per cent of the total consumption of the industry, and in 1935-8 it was about 12 per cent. The wool-using trades thus resemble the cotton industry in their reliance on foreign supplies of materials, although their degree of dependence is not quite so great.

Australia, New Zealand, South Africa and the Argentine, in that order of importance, are now the chief sources of supply. Although there are many varieties of wool, the two main types consist of merino and cross-bred wools. The former is a fine, long-staple wool and its use has increased greatly during the last few decades. This trend has meant a greater dependence on Australia and South Africa, since those countries together with the United States (which is itself a large importer of wool) are almost the only sources of world supply. New Zealand and the Argentine furnish most of the cross-bred wool imports into this country, and the British clip, together with Indian wool, is used chiefly in the manufacture of carpets and rugs. Some British wool is exported.

¹ *Survey of Textile Industries*, pp. 271, 275. Annual averages; greasy wool.

² Persons engaged in mungo-making, rag-grinding and carbonizing are included in the woollen branch, and persons engaged in combing and top-making in the worsted branch.

Although virgin wool provides the largest part of the industry's raw materials, recovered wool, which is obtained from rags and tailor's clippings, and wool pulled from imported sheepskins, make up an important part of the material supply. In addition, animal hairs such as mohair and alpaca, cotton, rayon and synthetic fibres are used. The extent to which materials other than virgin wool enter into the finished product not only differs widely from one section of the industry to another, but within each section it also varies from time to time with changes in the relative prices of the fibres. When the prices of raw wool are high, there is a tendency to substitute the cheaper wools for the more expensive (e.g. the finer cross-breds for merinos, and coarser cross-breds for medium cross-breds), and to introduce a larger admixture of recovered wool and of other types of fibre. Some of these other fibres can also be substituted for one another. For instance, since the war, rayon, previously of little importance in this trade, has been used in increasing quantities, chiefly because of its cheapness, to replace cotton as well as wool. Such changes are often made in response to the express demands of customers (especially the large clothing manufacturers) for stability in cloth prices. Lately, nylon has been used in the production of yarns with special qualities. During the first half of 1957, raw wool accounted for about 70 per cent and man-made fibres for about 10 per cent of the weight of materials employed. Thus wool textiles may be defined as goods produced by processes characteristic of this industry rather than of goods made from a particular raw material.

For a more complete understanding of these problems, it is necessary to distinguish between the woollen and the worsted sections. These constitute separate trades which use different types of raw material, different processes and different equipment. Their organization is dissimilar, and the technical and marketing problems of one are in sharp contrast with those of the other. Wool textile firms usually confine their activities to one of these two main branches. The worsted trade uses mainly merino and fine cross-bred wools. The woollen trade uses many kinds of raw wool, especially the medium and lower grades, short wool rejected by the worsted trade, other fibres such as cotton and rayon, and mungo and shoddy (or recovered wool). Although certain preparatory processes are common to both trades (e.g. washing and carding) there is a divergence of process after the material has been carded.

Carded wool for the worsted trade passes to combing machines. These rake the fibres parallel and separate the long fibres, called

"tops," from the short fibres called "noils." The "noils" are used by the woollen trade; the "tops" pass through subsequent processes to the worsted spinning-machines, and the yarn ultimately produced is composed of fibres uniform in diameter, length and direction. It is common for yarns made from other fibres, such as cotton, mohair, alpaca and silk, to be employed along with the worsted yarns on the looms producing worsted cloth. In the woollen trade there is no combing process; and the fibres used by spinners, besides being of diverse kinds, are short in staple. The yarn is composed of fibres mixed in all directions; for the aim of the spinner is to turn out a product which, though not as strong as worsted yarn, has better felting qualities. The woollen manufacturer produces cloth softer, though less smooth, than worsted cloth, and the composition of his yarn enables him to manufacture a great variety of finished fabrics.¹

Some of the outstanding characteristics of the wool-using industries may be brought out by comparing their structure with that of the cotton industry. In the former the purchasing of the raw materials is much less highly organized than in the latter. No "futures" dealings comparable to those conducted by members of the Liverpool Cotton Association exist for raw wool. This can be explained by the difficulty of grading the material and by the necessity for inspecting samples before purchase. The traditional method of sale is through agents of the producers who offer the wool at periodical London auctions. For many years, however, this practice has been giving place to a system of sales in the country of production and to direct shipments to manufacturers or merchants in the chief consuming districts.

The absence of an organized market meant, in the past, that producers were unable to safeguard themselves against price fluctuations by "hedging," as practised in the cotton industry, and they were, therefore, forced to reduce their risks by making contracts for the forward delivery of their goods and by buying materials only in sufficient quantities to cover their commitments. In times of violently fluctuating prices, such a method of trading was perilous, for when the prices of raw wool fell, customers sometimes refused to take

¹ In 1954, of the total weight of materials used by the woollen spinners, virgin wool made up about 48 per cent, noils and waste 12 per cent, mungo and shoddy 27 per cent, man-made fibres 8 per cent and cotton 2 per cent; in the worsted trade, virgin wool accounted for 92 per cent and rayon for about 5 per cent of the tops produced. In both branches, the proportion of raw wool used was much lower than in the early post-war years. Cf. D. C. Hague, *The Economics of Man-Made Fibres*, pp. 240, 255.

delivery of the finished goods. In an effort to meet this danger, traders on the Continent and in the United States have for many years operated a futures market in tops, a standardized commodity suitable for such dealings. During the fluctuations in prices at the time of the Korean war (the Bradford price of 64s merino tops fell in the course of six months during 1951 from 350*d.* a pound to 120*d.* a pound), some British traders were granted foreign exchange to enable them to "hedge" on the futures markets overseas. They were persuaded by this experience to advocate the establishment of a similar market in Great Britain.¹ The outcome was the creation in April 1953 of the futures market for tops in London. This has now outstripped the foreign markets in importance, and it is extensively used, chiefly for merino contracts, by wool merchants, topmakers and spinners.

On the producing side, the structure of the worsted branch bears a fairly close resemblance to that of the cotton industry; for the worsted trade is organized horizontally and it is usual for a producer to confine himself to a particular process. For example, the wool merchant or top-maker buys wool, sorts it and blends it, and then has it made into tops by a comber who works on commission. The spinner buys the tops for conversion into yarn, which may be either white or coloured. He then sells his product to the manufacturer who is likely to have the yarns warped and sized on commission before he weaves them. The cloth is then delivered to the piece-goods merchant who sends it out to be finished, again on commission, before distributing it. This sectional organization of the trade is not absolute. There are firms that combine combing and spinning; others that combine spinning and weaving; and yet others that engage in all three processes. Yet specialization is certainly typical. Thus, in 1935 there were 555 establishments engaged in the worsted spinning and weaving industry and these employed 110,000 persons. Ninety-six of these establishments, employing 30,000 persons, were engaged on both processes, while the remainder specialized in either spinning or weaving.² In the woollen branch, on the other hand, all the processes required for the manufacture of cloth are commonly conducted in the same establishment. For instance, in 1935, whereas in the worsted trade 60,000 persons out of

¹ B. S. Yamey, "Futures Trading in Cocoa, Rubber and Wool Tops" in *The Three Banks Review*, September 1954.

² *Census of Production, 1935*; see also, *Report of Working Party on Wool*, pp. 8 *et seq.*

the total employment of 110,000 persons were found in firms which specialized in spinning, in the woollen trade only 6,000 persons out of a total of more than 80,000 were in specialist spinning mills.¹ The following table, which covers only four processes and omits the normally specialized processes of dyeing, finishing and merchandising, brings out "the preponderance of firms engaged on a single process and illustrates the most striking exceptions to this—the normal association of wool-spinning and weaving in a single firm."² No significant changes in this respect have occurred since this table was compiled.

INTEGRATION OF PROCESSES, MAY 1946

<i>Process</i>	<i>Number of Firms Undertaking</i>				<i>Total Number of Firms</i>
	<i>1 Process</i>	<i>2 Processes</i>	<i>3 Processes</i>	<i>4 Processes</i>	
Combing ...	55	25	14	3	97
Worsted Spinning	184	68	25	3	280
Woollen Spinning	79	332	17	3	431
Weaving ...	331	355	19	3	708
NUMBER OF FIRMS	649	390	25	3	1,067

The reasons for the contrast in organization between the worsted and woollen sections are to be found to some extent in historical development. Worsted spinning went into the factories long before worsted weaving, and before any branch of the woollen trade. It thus became early established as a separate industry. Combing, the key process in the worsted trade, came under the control of specialist concerns after the middle of the nineteenth century because the machine combs, introduced at that time, were covered by patents. The stratification persisted for technical and commercial reasons. While the production of worsted yarn can best be conducted in large mills which specialize on particular grades, every worsted weaver makes use of a wide variety of yarns, and each class of yarn can best be obtained from specialists. Combing also is a process which, for commercial and technical reasons, can be conducted most economically in large specialized concerns. Furthermore, the products of the Yorkshire combing are not all used in local spinning mills, nor those of the spinner in local weaving sheds. There is not only a large

¹ *Ibid.*, pp. 8-9.² *Ibid.*, p. 12.

export both of tops and yarn, but also a considerable sale of yarn to industries other than the weaving industry, e.g. the hosiery industry. Consequently, combing and spinning capacity are necessarily much greater than is warranted by the local weavers' requirements, and as both these processes lend themselves to larger-scale productive methods than does worsted-weaving, this horizontal specialization is to be expected. In the woollen trade, on the other hand, the variety of products is so great that little opportunity is given for the large-scale production of standardized commodities. Success in the manufacture of woollen fabrics depends largely on the skilful blending of fibres for the production of yarns, and so the producers of piece-goods necessarily control also the spinning, finishing and other processes. Moreover, there is no stage corresponding to combing in the woollen trade, and the market for woollen yarn outside the industry is small.

On the whole, the size of firms and establishments in the wool-using trades, especially in the woollen branch, is smaller than in the cotton industry. It is true that in the combing, dyeing and finishing sections large firms predominate—two of the commission combers, for instance, produce about a quarter of the total output of tops; but in spinning and weaving there are numerous small firms, and no horizontal combine exists that can compare in size with the Lancashire Cotton Corporation. The Census of Production of 1951 recorded 1,502 *establishments* in the United Kingdom woollen and worsted industry employing 192,000 persons. Of these, 893 establishments with about 41,000 workers employed less than 100 persons each, and well over four-fifths of the workers were in establishments that employed less than 500 persons each.¹ Although some *firms* control more than one *establishment*—indeed there are a few very large businesses—the typical firm also is small, and except in combing, dyeing and finishing, the private firm and private limited company are responsible for much of the output. The contrast with the cotton industry, so far as the size of the technical unit is concerned, is perhaps best brought out by a comparison of the spindleage in cotton and worsted mills respectively. Whereas in cotton a mill with 100,000 spindles may be regarded as typical, in worsted spinning the normal size is in the range of 10,000 to 20,000 spindles.²

¹ These figures cover establishments employing over 10 persons. In 1951 there were in Great Britain 516 firms with 10 employees or fewer; together they employed nearly 3,000 persons.

² *Report of Working Party on Wool*, pp. 12-15.

Like the cotton industry the wool-using industry is strongly localized, and in 1951 over three-quarters of the workers in it were in the West and East Ridings of Yorkshire, mainly in the West Riding. The degree of concentration, however, varies from section to section. The worsted trade is found almost entirely in the West Riding, and the only other centres of production are Lancashire and Leicestershire. The woollen industry is more widely dispersed; but even in that branch the West Riding has two-thirds of the workers. The rest of the industry is found in centres famed for the manufacture of some of the best woollen cloth. The traditional seat of tweed manufacture, the Scottish Border, comes second in importance to the West Riding and produces many kinds of fine woollens. Another ancient home of the industry, the West of England, produces high-grade specialities. The Hebrides turn out Harris tweed, and there are small branches of the industry in other parts of Scotland and in Wales. Carpet making is carried on at Kidderminster and Glasgow as well as in Yorkshire.

Within the West Riding itself there is specialization by locality; but this is not so pronounced as the division between the spinning and weaving areas of Lancashire, and it is based on a different principle. The main distinction lies between the woollen area and the worsted area, although this is not clear-cut. On the whole, the district to the west and north, with Bradford, Halifax and Keighley, occupies itself mainly with worsted. The eastern and southern parts, with Leeds, Batley and Dewsbury, are chiefly concerned with woollens. Within each of these two areas there is still further specialization. Bradford, besides being the commercial centre of the industry, has most of the combing machinery and about a third of the worsted spindles, and it manufactures worsted dress goods for women's wear. Huddersfield produces both high-grade worsteds for men's wear and also fine woollens. Dewsbury and Batley concentrate on cheap woollens.

Since the Second World War there has been a tendency for the industry to establish itself in new centres, notably Rotherham, Darlington and Belfast. This movement has been induced by the shortage of labour in the West Riding, and the Working Party on the Wool Textile Industry favoured the setting up of branches in South Yorkshire where there are opportunities of enlisting the female members of miners' families.¹ South Yorkshire, moreover, is conveniently situated in relation to the North Midland area, the largest

¹ *Ibid.*, pp. 62-3.

market for hosiery yarn. It seems unlikely, however, that the location of the industry will undergo any considerable change, and there might be serious disadvantages in migration from the present centres. The West Riding not only possesses skilled and specialized labour and management, it also provides a wide range of facilities, which no new centre could hope to rival, for producers in all sections of the trade. Easy access to the external economies of large-scale production is a condition of success in most branches of this industry.

Except in the combing and finishing branches, the industry is highly competitive, as the presence of numerous small firms would lead us to suppose. But free and intense competition is here, as elsewhere, quite consistent with the existence of many market imperfections. The wide variety of finished products and the specialization of firms on particular processes and qualities of goods contribute to these imperfections, and business policy in the inter-war period tended to increase them. Some large manufacturing firms, for example, sought to escape from the prevailing insecurity by entering into long-term contracts with the larger makers-up and multiple clothiers; while other firms tried to build up a reputation for quality in their own special lines.¹ Nevertheless, few firms achieved a position which enabled them, by limiting the quantity of their output marketed, to control the prices of their products. An examination of the market structure will serve to bear this out.

The main product marketed by the industry is cloth of which the greater part is used in the manufacture of outerwear. Some of the tissues, however, consist of furnishing fabrics, blankets, and industrial cloths, and there are also the distinctive products of the carpet and rug industries. In addition to the finished cloth, however, intermediate products are marketed. Tops are sold to worsted spinners in other countries, and yarns to the hosiery industry at home and to foreign buyers. Wool fats are disposed of to manufacturers of cosmetics. In the marketing of most of these goods the merchants have an important part to play. The top-maker is often merely a merchant who buys raw wool, sorts and grades it, arranges for the tops to be made on commission, and then delivers them to the worsted spinners. Yarn required by local worsted manufacturers and by hosiery manufacturers is usually bought direct from the spinners; but about half the yarn exports are sold through yarn merchants. In the piece-goods trade half the supplies for the home

¹ *Ibid.*, pp. 14-15.

market pass direct from the manufacturer to the clothier or maker-up, or to the multiple-clothing concern. Most of the remainder goes through a cloth merchant who buys it in a finished state, or to a merchant converter who acquires the cloth "in the grey" and has it dyed and finished, for resale to the clothier, maker-up or retailer. The cloth merchant, or merchant converter, performs the functions of holding stocks, providing finance and ordering in quantity for subsequent disposal in smaller lots. In the direct trade which takes place between manufacturers and the larger clothiers and makers-up the latter carry out these functions and bear the market risks. In export markets over half the cloth is sold direct by manufacturers either through their own establishments abroad, or through agents. This form of sale is convenient in the case of the large customer-countries and where economic and legal conditions resemble our own. The rest of the cloth goes through merchants and merchant converters.¹ On the whole the Yorkshire industry has advanced farther than the cotton industry towards a system of direct trading in overseas markets. This may be attributed mainly to the fact that woollen and worsted goods, unlike cotton goods, have found their chief markets in countries inhabited by people of European descent, where legal systems are akin to the British. There is, therefore, less need in this industry than in the cotton trade for the kind of market knowledge that only a specialist can supply.

The organization of the woollen and worsted industry did not attract the criticism which was directed against that of the cotton industry in the inter-war period. This, no doubt, is mainly because the wool textile trade maintained itself more successfully than the cotton trade, and so was not required to make the structural adjustments necessary to the latter. It did not, however, completely escape proposals for remedial measures during the era of rationalization. For instance the representatives of the operatives, in evidence before a Court of Inquiry in 1930, suggested that costs could be reduced by the creation of larger producing units, increased specialization, the removal of uneconomical firms by a "scheme," and the extension of direct selling.² In the combing branch a "scheme" was in fact introduced in 1933 for the elimination of surplus capacity; but it is not clear that this had any result other than to strengthen the producer's control over the market for tops.

¹ *Ibid.*, pp. 91 *et seq.*

² *Report of a Court of Inquiry concerning a Wage Dispute in the Northern Counties Textile Industry*, pp. 19-20.

For the main branches of the industry the prescription in favour of large rationalized undertakings, standardized output and highly specialized plants was unconvincing in face of the wide fluctuations, through changes in fashion and other causes, to which the industry was liable. To meet such changes the chief quality required was flexibility for which very large concerns are seldom distinguished. It may be true that the deliberate policy of product differentiation, in an effort to escape from price competition, led to shorter runs and so to higher costs than would otherwise have existed. But one of the main sources of strength in this industry was its ability to produce specialities and goods of high quality, and a policy of standardization might well have meant the sacrifice of the advantages that the industry possessed in the manufacture of such products. The Working Party found little evidence in support of the view that a fundamental change in organization and structure was desirable. "Although there are wide variations in efficiency between the different firms in the industry," it stated, "... the evidence is hardly sufficient to warrant any conclusion in favour of the superior efficiency of firms in the larger size groups."¹ Further, although there were some important exceptions, it did not appear that the direct savings in production costs from long runs were large, and of course, there are many classes of product for which long runs are out of the question.² Success in export markets, it was held, depends largely on the producers' being able to offer a wide variety of designs and qualities, and this is hardly compatible with standardized production methods.

As the machinery used by the industry is very durable, its average age is high, and there was little replacement of old by new machines during the inter-war period. The Working Party reached the conclusion that the industry had been very conservative in installing new machinery and that it had not taken full advantage of developments in technique, especially on the woollen side. It believed that there was room for a considerable extension in the use of automatic machinery, especially in winding, warping and weaving; but since the industry was concerned primarily with goods of high quality, the desirable technical changes appeared to be limited to detailed improvements, and no case for a thorough transformation of mechanical methods was made out.³ The tentative nature of this criticism can no doubt be explained by the fact that firms in the industry, especially in the woollen branch,

¹ *Report of Working Party on Wool*, p. 71.

² *Ibid.*, pp. 71 *et seq.*

³ *Ibid.*, pp. 76 *et seq.*

are able to reach the same level of efficiency by many different routes. In these circumstances no single prescription can be justified.

The wool textile industry has thus retained its traditional structure with surprisingly few modifications during the last three decades. Its individualistic character remains and its problems have not called for concerted plans for reorganization as in cotton. This does not mean that co-operative efforts among the manufacturers have been lacking. On the contrary, since 1950, at the instance of the industry, a statutory levy has been collected from firms by the Wool Textile Delegation, which is a federation of sectional bodies. The proceeds of this levy have been applied to finance trade promotion overseas and the Wool Industries Research Association.

II

Trends in Production and Foreign Trade to 1939

The figures for the retained imports of raw wool indicate that the wool textile industry was growing steadily during the three or four decades that preceded the First World War. For this increase the greater home demand was entirely responsible. The industry did not share in the expansion of foreign trade that the cotton industry enjoyed during that period. Indeed, the volume of woollen and worsted exports declined steeply. Annual exports of tissues reached a maximum of 324 million linear yards in 1870-4 and then fell steadily for the next twenty-five years. With the turn of the century there was an improvement; nevertheless, in 1909-13 the annual average exports amounted to only 174 million linear yards.¹ This industry was obviously one of the trades most seriously affected by the change in the direction and composition of international trade during the last quarter of the nineteenth century.

Up to 1894 the decline had been shared by both woollens and worsteds. After then the fall in worsteds continued, but exports of woollen tissues increased. The growth was slow until the end of the century but rapid in subsequent years; the yardage of woollen goods exported nearly doubled between 1900-4 and 1909-13. It should be observed that these figures of yardage cannot be accepted as a precise measure of the changes in the industry's foreign trade. It appears that the decline in worsteds after 1894 was confined to particular classes of stuffs and narrow coatings, while in the woollen

¹ *Survey of Textile Industries*, p. 276. Annual averages.

branch the expansion took place in broad tissues. From this it follows that the apparent decline in worsteds must be discounted and that exports of woollens increased faster than the yardage figures indicate.¹ These qualifications, however, do not disturb the broad conclusions about the fall in the export trade between 1875 and 1914. The decline was not brought about by a fall in the world's consumption, for the production of raw wool grew substantially. Nor was it caused by the failure of Great Britain to maintain her share of international trade in these goods, for that share seems to have grown.² The cause lay in the establishment of woollen and worsted mills in countries previously supplied by Great Britain. The increasing self-sufficiency of the consuming countries in these goods is significant, since it foreshadowed a change which after 1914 disturbed many of the staple British trades.

That the wool-using industry was among the first to be affected by this tendency is to be explained by the fact that the chief consuming countries were those inhabited by people of European descent in a relatively high stage of economic development and capable of organizing their own factory industries. Even these countries could produce the more standardized worsted fabrics more easily than the variegated woollens, for the latter needed special knowledge, experience and skill, and this requirement accounts largely for the divergent trends of the two classes of exports. Again, worsted-weaving mills could be set up more readily than plants for combing or worsted-spinning. Consequently, while exports of worsted fabric fell throughout the period under review, exports of tops and worsted yarns rapidly increased. At this time countries were tending to specialize on particular classes of yarns and fabrics. France and Belgium, for example, were very skilful in the production of fine yarns from short staple wool and, just before 1914, there was a large import of these goods, equivalent in weight to about one-third of the yarn exports, into Great Britain. The imported yarns were employed by the women's dress goods and the hosiery and underwear trades. For many decades the volume of imported tissues had also been considerable, and in 1909-13 it amounted to about one-third of the exports (in yardage). The bulk of them came from France and Germany, and they consisted mainly of single-warp dress goods for the women's trade.³

¹ *Ibid.*, p. 172.

² *Ibid.*, p. 173.

³ Departmental Committee on the Textile Trades, *Report*, 1918 (Cmd. 9070), pp. 65-6, 68-9.

In 1912 about two-fifths of the output of woven tissues (in yardage) was exported, and the British producers supplied over four-fifths of the home consumption. Of the output of tops and of yarns, about one-seventh, mainly worsted yarns, was exported. The trade as a whole was then valued at over £36 million. Tissues accounted for 60 per cent of it, yarns for 23 per cent, tops for 10 per cent, and waste wool, noils and recovered wool for the rest. The markets for tissues were widely scattered. Europe, especially Western Europe, South America, India, Canada, United States, Australia and the Far East were the chief customers. Tops and yarns were sold mainly in European countries, especially in Germany.

During the First World War the industry, like others not directly concerned with the manufacture of munitions, was stationary. Although some sections were busy providing military equipment, manufacturers were unable to extend their plants or to serve their foreign customers. The shortage of raw material owing to the lack of shipping and to the remoteness of the chief supplying countries, Australia, New Zealand and South America, accentuated their difficulties. When the war was over the industry enjoyed a period of boom, and as few attempts were made to capitalize the prospects of future profit, it was not afflicted, like the cotton industry after the arrival of the slump, with over-capitalization. Further, although during the war countries previously dependent on British supplies had increased their own productive capacity, this development was not as marked in wool as in many other trades. It happened that the chief foreign industries were to be found in the belligerent countries, and new-comers to the industry in other parts of the world had difficulty in obtaining machinery. Yet the disturbances left by the war reduced the purchasing capacity of some of the leading customers and blocked the main channels of trade in semi-manufactured goods. The result was that in 1924 production was lower than in 1912. The incidence of the decline was unequal among the different sections. The output of tops and yarn had fallen only slightly; whereas the output of tissues was down by over a fifth, and most of this loss had occurred in worsteds. The exports of tops had been well maintained, and although the exports of yarns had fallen, the home demand for yarn had grown. For this the rise in consumption by the hosiery trade was wholly responsible as much less yarn was then being used by the weavers. The decline in weaving could not be attributed, as in the cotton trade, to the loss of foreign markets for tissues; for British exports had changed very little. Nor was increased foreign competi-

tion at home responsible; the volume of retained imports of tissues had, in fact, diminished. The reason was, therefore, the decrease in home demand. This, in turn, can be explained by changes in fashion which took the form of a preference for knitted goods and for fabrics other than woollen and worsted tissues. A reduction in the average yardage required for dresses had also taken place. The big drop in imports occurred because they consisted of a class of goods particularly susceptible to these fashion changes.¹

In spite of the absolute decline in output, Great Britain up to 1924 had certainly maintained her relative position as a wool manufacturing country, for world production had fallen to an extent equal to her own. It is probable that she had even increased her share of the reduced aggregate of international trade, and that a higher proportion of her own output was exported than before the war. The markets, however, had changed. The European, especially the German, demand for tops and yarn had fallen steeply; while larger markets had been found for these goods in the Far East and Canada. The Western European market for tissues had also diminished—a consequence of Europe's impoverishment—and demand from South America, India and Australia had also fallen. Against these losses, however, could be set substantial gains in exports to Japan and China. The adoption by Asian countries of Western habits of dress had thus balanced the decline of Europe as a consuming area. The change in markets was partly responsible for an alteration in the types of tissues exported. In 1924 exports of woollens were 37 million square yards greater than the annual average of 1909–13; but exports of worsteds were 42 million square yards less.² This was a continuation of a pre-war tendency which owed its origin to the growth of worsted manufacture in former importing countries and also to a change of fashion from worsteds to other fabrics.

After 1924 there was a deterioration in the British position. By 1925 the world's consumption of wool textiles is believed to have recovered to its pre-war level, and between then and 1929 it rose by about 12 per cent.³ International trade also increased during these years, though not in proportion to the rise in production, for importing countries were becoming more self-sufficient. The leading Continental exporters, especially Germany and Czechoslovakia,

¹ Board of Trade, Safeguarding of Industries, *Report of the Woollen and Worsted Committee* (1929), p. 11.

² *Survey of Textile Industries*, pp. 193–4, 276.

³ League of Nations, *Memorandum on Production and Trade, 1925 to 1929/30*, p. 79.

succeeded in increasing their foreign trade; whereas Great Britain was subject to both a relative and an absolute decline. Between 1924 and 1928 her production of tissues fell from 443 million square yards to 410 million square yards, and this was due entirely to a decline in exports.¹ In contrast with the trends before 1914, the losses were suffered in woollens as well as in worsteds. Competition in foreign markets from Germany and other countries was responsible for part of the worsening in Great Britain's position; but the main cause was her failure to maintain the new markets which she had gained in the Far East, where local manufactures had been established. As with most other British exports at this time, it was the bulk trade that suffered most seriously.² Meanwhile producers of women's dress materials lost some of their home trade, partly through the successful competition of foreign manufacturers in the British market, and partly through the continuance of the fashion trends already mentioned.

These fashion trends had different effects on the various sections of the industry. Demand moved from heavy to light fabrics and towards higher quality goods, a change which led to an increasing use of fine wools and to a smaller consumption of recovered wool. The result was that in the later twenties the branches of the industry that specialized on heavy fabrics and on goods made from recovered wool became deeply depressed. At the same time the demand for hosiery yarns continued to increase, so that a growing proportion of the worsted-spinning capacity became concerned with supplying hosiery yarns. Manufacturers for their part attempted to protect themselves against the effects of intense price competition by developing specialities; but this meant shorter runs and an increase in weaving and finishing costs. These consequences of attempts to increase the imperfections of the market were only partly offset by the effect on the industry of the growth in the importance of the multiple clothiers with their bulk orders.

The history of the industry during the World Depression resembled that of most of the older British trades. There was a heavy fall in the home demand for tissues, partly because of the persistence of unfavourable fashion trends, and partly because the steep decline in raw-wool prices led to hand-to-mouth buying on the part of pur-

¹ Board of Trade, Safeguarding of Industries, *Report of the Woollen and Worsted Committee*, p. 8.

² *Report of a Court of Inquiry concerning a Dispute in the Northern Counties Wool Textile Industry* (1930), p. 25.

chasers of finished goods. Until the industry was given the protection of a Safeguarding Duty, imports of lighter tissues for women's dress from the Continent made further inroads into the British market. The decline in exports was intensified. The deep depression among the leading agricultural countries in the temperate zone, which included the chief customers for British tissues, reduced their capacity to buy manufactured imports. Import duties on woollens and worsteds were raised in many of these countries, and in the Far East the substitution of Japanese for British goods continued. The class of exports most severely damaged by the depression was woollen tissues; these were halved in quantity between 1929 and 1931. In spite of the depression among the weavers, and although exports of yarns and tops fell, the worsted-spinners' business was well maintained, for they found comparatively buoyant markets in the hosiery industry.

The competitive strength of foreign manufacturers in the British market was weakened by the depreciation of sterling after September 1931 and their exports to Great Britain were shattered by the 50 per cent *ad valorem* duties imposed in November and December of that year. Even when these duties were replaced in April 1932 by a tariff of 20 per cent on tissues and 10 per cent on yarns, the trade failed to revive, and for the rest of the decade imports remained very small. The absence of foreign competition in the home market was in part responsible for the substantial recovery in the British output that took place during the middle and later thirties. Other important causes were the improvement in the real incomes of British consumers during that time and the reversal of fashion trends. In 1937 the home consumption of woollen and worsted tissues was more than a third greater than it had been in 1930 or in 1924, and practically the whole of the demand was then being satisfied by the British producers.¹ Yet this revival still left the home demand at only about three-quarters of that in 1912. The recovery of the export trade in tissues was more modest. Although exports rose from the low levels of the depression years, in 1937 they were (in quantity) barely four-fifths of those of 1929 and only 55 per cent of the annual average of 1909-13. The worsted yarn trade continued to benefit from the expansion in the hosiery industry, and in the late thirties nearly half the yarn consumed in Great Britain went to that industry or to hand-knitters. Exports of yarns, however, remained low, and on the eve of the Second World War their volume was only 55 per cent of that

¹ *Report of the Working Party on Wool*, pp. 23, 27.

of 1929 and about 40 per cent of the annual average of 1909-13. The export of tops, on the other hand, made a good recovery, and in the middle thirties it was higher than ever before. Later it fell away; but in 1937 and 1938 it was still above the level of 1929 and about equal to the annual export before the First World War.

During the thirties the exports became more widely dispersed. This came about chiefly through the fall in sales to the major markets. Just before the World Depression four markets (Canada, Japan and China, the United States and the Argentine) took 46 per cent of the total British exports of tissues (in volume). In the course of the next decade sales to all these destinations, except to the Argentine, declined steeply; the heaviest losses were sustained in the Far East. On the other hand, exports to New Zealand, South Africa and Denmark increased, and in 1937 the four chief customers, which were then Canada, Argentine, South Africa and the United States (in that order), took only 38 per cent of the exports. The same tendency could be observed in the yarn trade—an increasing dispersion of exports. There was a steep fall in yarn exports to Germany and an increase to countries that were newcomers to the wool textile industry. These changes were associated with the commercial policies of the leading customer countries. For example, the tightening of import restrictions in Central Europe reduced sales to that market, while the trade agreements between the United Kingdom and the Argentine and Denmark helped to maintain or to extend exports to those destinations. In this respect the markets of the wool textile trade were affected by the same influences as those of many other British industries during the thirties.

The absolute decline in British exports did not lead to any worsening of her relative position in international trade in woollens and worsteds. During this period all the exporting countries, with the exception of Japan, lost ground, and world trade as a whole shrank to an even greater extent than the British. France and Germany were especially hard hit. The result was that Great Britain had a larger share of the total international trade during the later thirties than she enjoyed a decade earlier, although of course the total volume of that trade had become much smaller.¹

It is now convenient to summarize the experience of the industry during the quarter of a century before the Second World War. On

¹ In the period 1935-8 Great Britain was responsible for 37 per cent of the total international trade in tops, 30 per cent of that in yarns, and 48 per cent of that in tissues. (The comparisons are in terms of quantity.)

the whole wool textiles had suffered much less than the other staple industries from the misfortunes of the period. In 1937 the output of the main finished product, tissues, was only 16 per cent less in volume than it had been before 1914—a much smaller decline than had occurred in the rest of the older textile trades. The whole of the loss, moreover, had occurred before 1924; for the subsequent losses that took place in production for export were offset by increases in production for the home market. In intermediate products experience was more favourable, for the output of tops in 1937 was about the same and the output of yarns rather higher than before 1914. It may seem remarkable that the output of tissues should have been so well maintained, in spite of the heavy fall in exports and in home consumption. The explanation is to be found in the displacement of imports by goods of British manufacture, for the reduction in these imports was just about equivalent to the amount by which home demand had fallen off. The net loss in the output of tissues during these twenty-five years can, therefore, be ascribed wholly to the fall in exports. This, in turn, was attributable not to the successful competition of other countries in international trade, but to the tendency of foreign countries towards greater self-sufficiency in this class of goods.¹ The relatively greater success of the yarn trade was based almost entirely on the expansion of the hosiery industry.

III

The Wool Textile Industry after 1945

During the Second World War the wool textile industry shrank under the impact of restrictions designed to transfer its resources to war purposes, and its foreign sales became insignificant. Like the cotton industry, it found its re-establishment after 1945 handicapped by a shortage of labour. The insured labour force had diminished during the inter-war period—from 260,000 in 1924 to 227,000 in 1939; but even so the proportion unemployed between 1935 and 1938 ranged between 10 and 20 per cent. The war-time measures reduced the number of workers to 126,000 in 1944, and the task of rebuilding the force was very formidable. The chief shortage was in women workers. This industry employs a high proportion of women—the ratio of women to men is normally 130:100—and in

¹ In 1937 only 28 per cent of the output of British tissues was exported, compared with 50 per cent in 1924 and 40 per cent in 1912.

the past it was possible to obtain the numbers needed because in the West Riding it was the custom for many married women to offer themselves for employment. After the outbreak of the war these were drawn into other industries, especially to engineering, and they showed a reluctance to return to their former jobs. Furthermore, juveniles, on whom the industry depends for many processes, became scarce through the fall in the birth-rate during the inter-war years, the raising of the school-leaving age and the attractions of other industries. As the average age of the workers in the industry was high, a large annual recruitment of juveniles was needed merely to replace wastage. Nevertheless, despite these difficulties, which were accentuated by the conditions of full employment in the economy as a whole, the labour force had been restored to within 8 per cent of its pre-war size by 1950. Since then, while there have been fluctuations in employment, no substantial change has occurred. In 1957-8 the numbers engaged in the industry were slightly lower than in 1949-50.

The shortage of labour during the immediate post-war period meant that the industry was unable for some years to raise its output sufficiently to meet the strong demand that then existed from both home and foreign consumers. In 1948, for instance, the output of worsted yarn was still about 20 per cent less than in 1937. However, since home demand was kept down by rationing, the industry was able to restore its exports to the pre-war level, and since its former chief competitors were absent from the world's markets, its foreign sales were very profitable. This period of recovery and prosperity was brought to an abrupt end by the textile slump that followed the boom of 1950-1. Yet, whereas in the case of cotton, the slump marked the beginning of another secular decline, in wool textiles it was short-lived, and by 1953 output had been restored almost to pre-slump levels. Since then the output has shown a slight upward trend.

The pre-war tendency for the worsted section to become relatively more important has persisted, partly because fashion has favoured worsted rather than woollen fabrics for women's wear, and partly because the demand for knitting yarns has continued to grow. These changes have affected the amount of capacity in the various branches of the trade. A reduction has occurred in the total amount of spinning and weaving equipment, but since the machines have been speeded up and unit-output increased, this does not represent a fall in effective capacity. In fact, effective capacity in worsteds is larger than before the war, whereas in woollens it is rather less.¹

¹ Cf. *Economist*, August 24th, 1957, p. 629.

Fluctuations in raw material prices have always been a major preoccupation in this trade and have at times been very damaging to the textile producers.¹ During the post-war period they have been particularly violent and disturbing, despite the fact that at the end of the Second World War policy was deliberately directed towards maintaining a measure of price stability. The course of these price movements and their consequences demand attention.

The large stocks of raw wool that had accumulated during the war amounted in 1945 to two years' consumption, and it was then estimated that it would take twelve or thirteen years to dispose of them concurrently with the annual clip. A Joint Organization was, therefore set up to handle the surplus Dominion wool and to maintain a reasonable stability of prices. On its formation it took over the British Government's holdings of wool. It is an ironical commentary on the capacity for economic prediction that by July 1948 the stocks held by the Joint Organization were already only one-third of the quantity taken over in August 1945, and that by the beginning of 1950 they were almost completely exhausted.² The same decline occurred in the stocks of South American wool which were not held by the Joint Organization. During this period, moreover, fine wools soon became very scarce, because it was found that the stocks consisted of a large proportion of low quality wool. The result was that wool prices, far from showing greater stability than before the war, rose faster than most other commodity prices. Fine wools, which in January 1946 were sold at British and Dominion auctions at prices less than 20 per cent above the annual averages for 1934-8, by July 1948 had trebled in price. Early in 1950 they were about four times as great as they had been before the war. The major causes of the rapid disposal of the wool stocks were the high import into the United States and the unexpectedly quick recovery of some of the European wool-using industries at a time when the world production of raw wool was running well below consumption. With the outbreak of the Korean War governments began stockpiling raw materials, while merchants bought heavily in anticipation of a continuing boom. Consequently prices rose further until in March 1951 they were eight times as high as before the war. Then

¹ See, B. P. Philpott, "Fluctuations in Wool Prices, 1870-1953" in *Yorkshire Bulletin of Economic and Social Research*, January 1956.

² In 1945 the Joint Organization's stocks amounted to 10,400,000 bales of Australian, New Zealand and South African wool. By the summer of 1949 they had been reduced to 1,700,000, and by December 1950 to 173,000 bales.

the boom suddenly collapsed and in six months prices were halved.¹ The fluctuations since then have been less dramatic although of considerable amplitude. They have had marked effects not only on the fortunes of the wool textile producers and on the types of fibres used in the mills, but also on methods of trading. To an increasing extent the burden of stockholding has been thrown on the growers and the tendency for the proportion of wool sent to London auctions to fall has continued.

If, in spite of the presence of this de-stabilizing factor, the wool textile industry has enjoyed greater prosperity than the cotton industry since the war, this is mainly attributable to its different experience in international trade. Great Britain has retained her position as the chief supplier of woollen and worsted goods. Her exports of these products during the middle fifties were larger in quantity than before the war, and they now form a rather higher proportion of her total output. It was not surprising that the export trade should have flourished immediately after the war when the other main exporters were out of the market. But the maintenance of this high volume of trade during the fifties despite the reconstruction of the industries of former rivals, and despite the increasing tendency for customer-countries to establish their own manufactures, testifies to the competitive strength of this British industry.

As in pre-war days, the foreign markets have been widely dispersed. The chief customers for fabrics have been found in countries with a high income a head. Canada has remained the best customer, but a marked growth has occurred in sales to the United States where the demand for high-grade British fabrics has been very strong. In 1957 those two countries together took over a quarter of the total exports (in value) of woollen and worsted yarns and woven fabrics. Thus the industry has been a most important dollar earner. Europe, especially Western Europe, has also increased its purchases, and recently that continent (excluding the Russian satellite countries) has taken over a third of the total exports of yarns and fabrics. On the other hand, there has been a fall in sales to certain distant markets, including South and Central America. In some parts of the world where the development of the local industry has damped down the demand for British yarns and fabrics, it has enlarged the opportunities for the

¹ J. F. Brothwell, "The 1951 Depression in the British Wool Industry", in *Yorkshire Bulletin of Economic and Social Research*, September, 1952; and P. Nettl, "Some Economic Aspects of the Wool Trade" in *Oxford Economic Papers*, July 1952.

trade in tops, a product of a highly capitalized process which newcomers to the industry find less easy to undertake than spinning and weaving. The result was that during the fifties exports of tops in quantity were nearly double those of pre-war years. Most of them went to the less highly industrialized countries of the East. In 1956 China and India were the chief buyers. Japan also became an important customer as her wool spinning and weaving industry revived.

As already shown, some share of the British home market has for many years been supplied by European producers, and after the reconstruction of the continental industries this competition was resumed. In the middle fifties, however, only about 5 per cent of the total British consumption of fabrics was supplied from imports. These consisted largely of cheap woollens from Italy. In addition, relatively small quantities of special yarns were bought from France and there was, as before the war, an import of cheap Belgian carpets.¹

PRODUCTION OF TOPS, YARNS AND TISSUES IN THE UNITED KINGDOM

<i>Year</i>	<i>Tops</i> (in million lb.)	<i>Yarns</i> (in million lb.)	<i>Tissues</i> ² (in million sq. yds.)
1907	243.5	446.0	529.6
1912	304.5	565.1	572.5
1924	285.5	554.5	440.0
1930	224.5	385.9	324.1
1935	307.5	543.0	412.9
1937	278.5	565.8	445.5
1949	286.4	528.6	438.6
1950	316.3	556.0	450.3
1951	241.4	501.3	418.1
1952	331.1	455.1	377.9
1953	322.9	534.9	411.8
1954	303.8	538.6	414.4
1955	309.5	538.8	410.0
1956	321.2	530.2	396.6
1957	324.8	537.4	394.0

¹ Cf. Economist Intelligence Unit, *Britain and Europe*, pp. 214-15.

² The figures for tissues exclude damasks and plushes, flannels, delaines and blankets. The returns for 1907 and 1912 were made in linear yards, and the figures have been converted into square yards by adding one-third. The figures for 1949 and subsequent years are for "deliveries", as output figures are not available; they are, therefore, not completely comparable with the others in this column. This applies also to the figures for yarn from 1949 onwards.

The competition has been insignificant, however, compared with that which the cotton industry has had to meet during the last few years. Wage disparities between British and continental wool textile producers are very small compared with those between British and

EXPORT TRADE IN WOOLLEN AND WORSTED GOODS¹

<i>Year</i>	<i>Tops</i> (in million lb.)	<i>Woollen and</i> <i>Worsted Yarns</i> (in million lb.)	<i>Woollen</i> <i>Tissues</i> (in million sq. yds.)	<i>Worsted</i> <i>Tissues</i> (in million sq. yds.)
1909-13 average	41.9	87.0	127.5	98.4
1924	41.1	65.9	164.7	56.8
1925	32.0	57.4	132.2	47.3
1926	33.6	47.3	119.4	42.9
1927	41.9	69.1	130.9	40.0
1928	34.4	66.0	128.3	42.1
1929	32.7	63.6	108.2	47.3
1930	28.8	49.6	79.0	34.7
1931	28.0	45.4	56.3	29.7
1932	41.8	47.5	53.5	28.3
1933	45.8	53.8	61.3	32.9
1934	41.7	52.0	68.9	33.3
1935	55.9	50.7	71.3	38.6
1936	52.1	46.6	78.2	39.8
1937	40.2	41.4	79.8	43.0
1938	32.5	34.7	58.9	31.6
1946	28.1	15.1	51.1	22.4
1947	38.5	14.4	51.7	24.2
1948	59.5	20.8	69.9	34.8
1949	60.1	29.0	70.1	35.9
1950	73.0	35.2	77.0	40.3
1951	49.3	26.6	70.2	39.0
1952	54.0	25.3	58.2	33.6
1953	70.1	28.8	62.1	34.5
1954	67.1	25.5	59.2	31.6
1955	76.6	26.4	68.3	34.3
1956	81.6	28.9	71.0	33.3
1957	83.3	29.9	69.7	34.2

¹ As the Trade Accounts show linear yardage before 1920 and square yardage in 1920 and subsequent years, it is not possible to compare accurately the export trade in tissues for years before and after the First World War. The estimated square yardage for 1909-13 is from the *Survey of Textile Industries*. Further, for the purpose of comparison with 1909-13, the figures after 1923 exaggerate the total exports by between 2½ and 3 per cent, owing to the inclusion of trade with the Irish Free State after that year. The figures showing yarn

Asian cotton goods producers. At the same time labour productivity in British wool textiles compares favourably with that of other countries. It must be added, however, that whereas the wool textile industry is effectively protected by a tariff ($7\frac{1}{2}$ per cent *ad valorem* on yarn and $17\frac{1}{2}$ per cent on fabrics), the cotton industry has had to face duty-free imports from the Commonwealth countries.

exports include yarns made of alpaca, mohair, cashmere and certain other materials. The figures for worsted tissues for 1949 and subsequent years are not completely comparable with those of earlier years because of the omission of certain categories of goods.

CHAPTER XI

RAYON

I

Genesis and Growth

The textile industries have always been based on the use of a few natural fibres, especially cotton, wool, silk, linen and jute, and the vast bulk of the world's output of yarns and fabrics is still made from these materials.¹ During the present century, however, and particularly within the last thirty years, rivals have appeared in the form of synthetic or semi-synthetic materials, usually known as man-made fibres. These differ widely one from another. The most important of them is rayon, a semi-synthetic fibre produced from cellulose derived from wood pulp and cotton linters. Others are derived from a natural protein base, such as the fibres made from skimmed milk, and yet others from polymers. The latter (the non-cellulosic fibres) have become important only during the last twenty years. In this country the best known are nylon and Terylene, for the production of which large factories were established after the Second World War.

All the man-made fibres are the outcome of chemical discoveries. They owe their origin to scientific research and their development to recent advances in industrial chemistry and chemical engineering. Rayon, as a commercial product, may be said to have originated in the work of de Chardonnet, for although several other chemists were responsible for valuable experimental investigations, it was he who first bridged the gap between the discoveries of the laboratory and manufacture for the market. Chardonnet's factory at Besançon, established in 1890, was the first rayon (or artificial silk) factory in the world. His process known as the Chardonnet or nitro-cellulose process, did not for long remain the only or the chief method of manufacturing rayon. Just before the end of the century a factory was set up at Elberfeld to work the cupra-ammonium process, and at about the same time the viscose process came into use in several

¹ It is estimated that in 1955-6 about 85 per cent of the world production of textile fibres consisted of natural fibres.

countries, including Great Britain and the United States, for the production of textile yarns. The fourth and latest process to be developed commercially was the cellulose acetate process; this was introduced for making rayon yarns shortly after the First World War. In all these processes the cellulose, obtained from wood pulp or cotton linters, is treated with chemicals, forced through small jets in a spinneret and then solidified in the form of a filament. After further chemical treatment it may be converted into continuous filament yarn by a doubling process, or it may be cut into lengths and then spun into staple fibre yarn. The two main products of the rayon industry thus resemble those of the real silk industry, inasmuch as one consists of a continuous filament and the other a spun product (called spun silk in the silk trade).

The four systems used for producing rayon differ to some extent both in the raw materials and the chemical processes employed, and also in the finished products, which vary in strength, fineness, lustre and other qualities. The viscose process soon outstripped the others, and in 1937 85 per cent of the world's output of filament yarn was viscose yarn, compared with 12 per cent acetate, 2 per cent cupra-ammonium and 1 per cent nitro-cellulose yarn.¹ Practically all the staple fibre was manufactured by the viscose process. Since then, for reasons presently to be given, the share of filament produced by the acetate process has increased and it amounted in 1956 to about 16 per cent of the total; but the proportion of staple fibre manufactured by processes other than the viscose process is still very small.

The growth of the rayon industry was at first handicapped by defects in the new fibre which took some years to overcome, and even in 1913 world output was only about 11,000 metric tons. Nevertheless, by then rayon production had been started in all the leading industrial countries. At that time the United Kingdom, where the industry had been introduced in the early years of the century, and Germany were the largest producers.² France and Italy were the next most important manufacturing countries. During the First World War production increased substantially and spread to new countries, notably Japan. Up to the war only continuous filament had been produced but the shortage of natural fibres in Central Europe between 1914 and 1918 led to the introduction of staple fibre production, although the output for long remained very small.

¹ G. Blau, *World Fibre Survey* (F.A.O. Report, 1947), p. 48 n.

² M. H. Avram, *The Rayon Industry*, p. 112.

With the coming of peace, the industry began a rapid advance which has continued ever since. World output rose to 35,000 metric tons in 1922, 85,000 metric tons in 1925, and 200,000 metric tons in 1929. Even the Great Depression did not bring a decline, and in 1932 output reached 243,000 metric tons. The thirties was a period of very rapid growth. Output reached 831,000 metric tons in 1937 and 1,022,000 metric tons in 1939. Until the thirties practically the whole output consisted of continuous filament, but after 1932 staple fibre production rose steeply and in 1939 it accounted for about 500,000 metric tons, nearly half the total rayon output. After the Second World War the rapid advance continued in spite of the appearance on the market of pure synthetic fibres. In 1956 the world output of rayon reached about 2.4 million metric tons, well over twice the pre-war output, and about three-fifths of it consisted of staple fibre.

The growth of the industry was dependent upon a combination of factors—the skill of the manufacturers in improving quality and in devising new varieties of rayon, the fall in the price of rayon in relation to that of natural fibres, changes of fashion and economic policy. Technical progress which enabled the industry to produce yarns of higher tensile strength and greater attractiveness for clothing was achieved by a series of chemical and mechanical discoveries.¹ The invention of the centrifugal spinning box by Topham in 1900, which provided for collecting and twisting the viscose thread as it emerged from the spinnerets, solved one of the major mechanical problems, while the introduction just before the First World War of the Napper bath, which enabled the plasticity of the filament to be controlled, increased the capacity of the industry to turn out strong and fine yarns. In the twenties the manufacturers discovered how to produce a strong rayon warp and also crêpe yarns and delustred yarns. During the next decade the main technical problems that arose in the production of staple fibre from low-grade wood pulp were solved and, in addition to detailed improvements in the manufacture of both viscose and acetate filament yarns for dress purposes, a new type of filament was devised (high tenacity filament) which proved suitable for industrial purposes, especially for the manufacture of motor tyres. Throughout the inter-war period, and since then, various technical advances have led to economies in the use of materials, especially chemicals, and in recent times greater efficiency in staple fibre spin-

¹ For detailed information about processes and technical development, see R. Robson, *The Man-Made Fibres Industry*, esp. Chaps. I and II, and D. C. Hague, *op. cit.*, Chap. II.

ning has been achieved by the elimination of intermediate processes, as by the "tow to top" system.¹

These technical advances were accompanied by a marked fall in the price of rayon compared with that of natural fibres. By 1927 rayon yarn was selling at less than its price before the First World War, whereas Egyptian cotton yarn of comparable fineness was 66 per cent above its pre-war price and Botany worsteds 87 per cent above.² After 1927 the decline in rayon prices continued and in the next ten years the price of filament fell by three-fifths. The change may be emphasized by stating that in 1920 the price of filament was about equal to that of raw silk; by 1933 it was less than half the price of raw silk which itself had fallen steeply. By this time rayon was becoming a competitor of cotton. Viscose rayon filament, which in 1929 was three and a half times as dear as cotton yarn of comparable fineness, by 1939 was only two and a half times as dear. After the Second World War the price advantage in favour of rayon increased, and in the late forties and early fifties filament yarns were considerably cheaper than cotton yarns. The relative movements of staple and natural fibre prices were even more striking. In 1929 staple fibre cost four times as much as American raw cotton; by 1939 it cost only 25 per cent more, and in the late forties and early fifties it was far cheaper. In 1939 spun rayon yarn was 18·2*d.* a pound, while American cotton yarn was 11·6*d.* a pound; in 1951 the prices were 37·7*d.* and 60·5*d.* respectively.³ These circumstances were conducive to the substitution of rayon for natural fibres even in the absence of other favourable conditions. It is true that the fall in raw cotton prices during the middle fifties, accompanied as it was by a rise in rayon prices, reduced the competitive strength of rayon and was in some degree responsible for retarding the progress of some sections of the industry. Yet, even in 1957, spun rayon yarn was still much cheaper than American cotton yarn.

To these favourable price influences were added those of fashion and of policy. After the First World War the trend of fashion was towards lighter fabrics for which rayon was well suited. By the thirties both Westerners and Asians had taken to wearing rayon

¹ The "tow" is formed by bringing together the bundles of filaments as they emerge from the spinnerets. It is normally cut to the required staple length and subjected to a series of processes, including carding, preparatory to spinning. The "tow to top" system is designed to cut the "tow" without interrupting its continuity and to proceed direct to the formation of a sliver for spinning. See, R. Robson, *op. cit.*, p. 14.

² *Survey of Textile Industries*, p. 304.

³ See, Table, p. 292, *infra*. All these are British prices.

clothes in partial replacement of those made from silk or spun silk and even cotton. In that decade, moreover, policy came to the assistance of the industry. The development of staple fibre production was fostered by the governments of Germany, Italy and Japan as part of their attempt to lessen their dependence upon imports of natural fibres. In Germany an official levy was imposed on textile mills, and the funds so obtained were used to finance staple fibre plants. In all these three countries producers of fabrics after the middle thirties were required to use certain proportions of staple fibre in the manufacture of all textiles for domestic consumption. In Japan, after 1938, the use of raw cotton in the production of textiles for the home market was forbidden and the way was open for the further development of staple fibre. Thus, technical advance, changes in fashion and economic policy all favoured the growth of the world's rayon industry during the inter-war years.

We conclude this general survey of the development of the world's rayon industry by noting the stages by which rayon achieved its penetration into the textile manufacturing trades and by observing the present uses of the variety of products for which the industry is now responsible. At first rayon filament was used chiefly for embroidery and braids, and then, just before the First World War, as the strength of the yarns was increased, it found markets among the knitters. During the next decade it was increasingly employed by weavers, but up to the middle twenties its use was confined to mixtures made from a cotton warp and a rayon weft, for the yarn was still too weak to permit satisfactory all-rayon fabrics to be woven. At that time about half the world's output of rayon was consumed by the knitters, and the filament was still regarded primarily as a substitute for silk. In the late twenties, as the tenacity of the yarn was improved and as prices fell, woven rayon goods (pure rayon as well as mixtures) came to be extensively produced, and in the thirties the rayon manufacturers found their main market in the cotton-weaving industry. After the middle thirties staple fibre, used mainly as a substitute for raw cotton by the cotton spinners, began its rapid advance, and a beginning was made with the manufacture of high tenacity rayon filament. Since the Second World War important changes have occurred in the relative importance of the several classes of product. Synthetic fibres have tended to replace rayon filament in the hosiery trade, while fashion has favoured the use of acetate rather than viscose yarn for clothing and household textiles in general. The result is that the output of viscose low tenacity yarn has grown

very little since before the war, while the acetate output has more than doubled. The main advances have occurred, however, in the manufacture of staple fibre and of viscose high tenacity filament for industrial purposes.

The history of the British production faithfully reflects these changes in the world's rayon industry during the present century. The United Kingdom producers did not for long retain the leading place which they had occupied in 1913. By 1922 the United States had become the chief producer, and by 1925 Italy had gained the second place and the United Kingdom had dropped to third. By 1929 the German output also had exceeded the British, and this country's proportion of the world output had fallen to 12 per cent, compared with 20 per cent in 1922. This relative decline, however, was consistent with a large absolute advance in the British output which in 1929 was three times that of 1922. During the next decade the British output of continuous filament yarn more than doubled, but as the expansion in the rest of the world was even greater, the British share of the total output of filament yarn fell, by 1939, to 10 per cent. Great Britain's staple fibre output, which was very small until the middle thirties, was only 5 per cent of the world's total in 1939. On the eve of the Second World War, the leading producers of filaments were the United States and Japan. Great Britain's output was only a third of the American and half the Japanese. In staple fibre Germany, Japan, the United States and Italy, in that order, were the major producers. In international trade Great Britain was far behind these countries. During the later thirties the greater part of the world exports were provided by Japan and Italy, and the British share in them was very small. It is thus clear that although this country built up a large rayon industry during the inter-war years, she did not succeed in winning in this new manufacture a place comparable to that which she had once occupied in the older textiles.

During the Second World War the British rayon industry suffered less than the older textile trades from the government's policy of diverting resources from the peace-time to the war industries, and in 1945 the output of rayon was about the same as the annual average for 1936-8. After the war its growth was very rapid and in 1957 output was two and a half times that of the pre-war years. This expansion came about chiefly through the increase in staple fibre production, now four times the pre-war output, and through the appearance of a large manufacture of high tenacity filament. The

increase in the output of low tenacity filament has occurred wholly in acetate.

These changes in the relative importance of the different types of rayon in Great Britain correspond to changes in the class of customer-industries served. In 1939 about 60 per cent of the filament yarn was woven into cloth by weavers in the cotton industry, about 27 per cent was used by the knitters, 6 per cent was exported and the rest was taken chiefly by the narrow fabrics and the lace trades. In 1956, in consequence of the changes just described, the weavers were taking a higher proportion, about two-thirds of the total. This increase, however, was attributable entirely to the new market for high tenacity rayon in the motor tyre industry, for the proportion used by weavers for clothing and household textiles had fallen to about 37 per cent. The share sold to the knitters had also dropped—to 16 per cent.¹ Exports of filament, which like output had been well maintained during the war, rose sharply after 1945 and by 1950 were twice the pre-war quantity. In spite of a slight decline in the early and middle fifties, they amounted in 1956 to about 12 per cent of the total deliveries of filament yarn. As for staple fibre, in 1939 nearly one-third of the output was exported and most of the remainder was spun into yarn by the cotton industry. By 1956 the proportion exported had fallen to 11 per cent (although absolute quantities had, of course, greatly increased), and while the cotton spinners remained by far the most important customers for home deliveries, considerable amounts were then being spun by the woollen and worsted, flax and jute industries.

It is clear that the direct exports of the rayon industry have at no time made up a high proportion of the total output. In this respect Great Britain conforms to a general pattern. International trade in rayon textiles, however, is of far greater importance, and a correct appraisal of the British position requires an examination of the export trade in those goods. In 1937 the world's production of pure rayon fabrics was estimated to be about 5,000 million square yards, of which about 700 million square yards entered into international trade. Most of this trade was in the hands of the Japanese. The United Kingdom, which then produced 322 million square yards, exported about 38 million square yards. These exports had grown substantially during the thirties, but they were still very small in relation to those of other countries. Most of the goods went to the British Empire, especially the Dominions, and the trade depended

¹ Cf. R. Robson, *op. cit.*, p. 28.

largely on the tariff preferences which the United Kingdom enjoyed in those countries. In addition, there had been during the twenties a substantial output and export of cloth made from rayon mixed with cotton yarn; but this trade fell off during the thirties. On the eve of the Second World War the total value of British exports of rayon and rayon fabrics was only about £5 million a year, about one-tenth of the value of the cotton exports at that time. Thus the British industry sold most of its output in the home market and it played only a modest part in world trade either in yarn or fabrics. Its strong position in the home market, moreover, depended to some extent upon the existence of a protective tariff.¹ On the other hand, as we shall see presently, British firms had done much to develop the industry overseas.

During the immediate post-war years the tendency for exports of rayon mixture cloths to decline continued, but exports of pure rayon fabrics rose substantially, and in 1949 and 1950 they were four times as great (in square yardage) as before the war. After 1951 the foreign markets for rayon products suffered from the general textile slump, and although there was some recovery in 1953 and 1954, subsequently another decline set in. Nevertheless, throughout this period, exports of rayon fabrics have remained much higher than before the war and, since this rise has been accompanied by a steep fall in the cotton piece-goods trade, the ratio of rayon to cotton exports has much increased. Whereas in 1937 this ratio (in terms of square yards) was only about 4 per cent, in 1956 it had risen to 25 per cent.² In value the ratio of exports of all man-made fibre products to those of cotton yarn and fabrics rose from 8 per cent in the period 1935-8 to

¹ During the early twenties the industry suffered from foreign competition in the home market; but after 1925 the imports were reduced as a result of the imposition of an import duty of 2s. a pound on rayon yarn and 3s. 6d. a pound on rayon fabrics. The protective effect of these duties was by no means removed by the imposition of excise duties of 1s. 0d. a pound on yarn and 6d. a pound on staple, although it may be argued that the latter duties must have retarded the substitution of rayon for natural fibres by the textile trades. In 1934 all these duties were lowered (the excise on staple was abolished in 1935), but the differential between import and excise duties remained and the fall in rayon prices at that time left the industry highly protected in the home market. At present the import duties are 9d. a pound on staple, 9d. a pound plus 20 per cent *ad valorem* on filament or spun yarn, and 11d. a pound plus 22½ per cent *ad valorem* on pure rayon fabrics. High duties such as these are common to many countries and are to be regarded as "a legacy of rayon's original reputation as a substitute for silk and therefore a luxury." (Economist Intelligence Unit, *Britain and Europe*, pp. 223-4.)

² Rayon fabrics, for the purpose of this comparison, include both pure rayon and rayon mixtures.

36 per cent in the period 1955-7. Yet this growth in rayon exports still left Great Britain with a modest share of the world's trade—in 1956 it was about 6 per cent for both staple fibre and fabrics and about 11 per cent for yarn.¹ Japan, Italy and Western Germany were far ahead of the United Kingdom. These countries were not only successful competitors with the United Kingdom in foreign markets, but, in spite of the high British tariff, in recent years they have supplied the home market with a quantity of fabrics equivalent to about half the British exports. A high proportion of the imports consisted of spun rayon grey cloth for finishing and re-export and most of them came from Continental Europe and Japan.

II

The Structure of the Industry

The older textile industries had their origins in small-scale domestic trades which were transformed into factory industries by a series of mechanical discoveries. Even today each of these industries is made up of numerous independent firms of varying size, some of them quite small. The rayon industry, however, from the outset used large and highly mechanized plants and was essentially a product of modern applied science. Its structure stands, therefore, in sharp contrast with that of the older textiles, and in all countries it has from the beginning been in the hands of a small number of firms, most of them very large. Its continued progress has depended upon the producers' skill in organizing large-scale research, their alertness in seizing the opportunities presented by the discoveries of independent inventors, and their readiness to invest heavily in development work.

In the United Kingdom the leading place in industry has from the beginning been taken by Courtaulds. As with most firms in the newer industries, Courtaulds' rayon business grew out of their earlier concern with an allied branch of production.² At the end of the eighteenth century the family was engaged in silk-throwing at Braintree, Essex. To that business they added in the early nineteenth century the manufacture and finishing of black crêpe and other silk fabrics, and they also produced the machinery required in their factories. Unlike many silk manufacturers, they survived the aboli-

¹ R. Robson, *The Man-Made Fibres Industry*, p. 38.

² C. H. Ward-Jackson, *A History of Courtaulds*, *passim*.

tion in 1860 of the import duties on French silks, largely through their skill in the production of mourning crêpe. The death of Prince Albert in 1861, which plunged the Court into a long period of mourning, profoundly affected the fashion in dress and so gave a sharp stimulus to the output of Courtaulds' speciality at a time when the rest of the silk industry was decaying. When in the eighties demand for other silk fabrics expanded, the firm broadened the basis of its output; but until the end of the century its fortunes still rested on the production of black crêpe.

Meanwhile, the early experiments in rayon were being made. In 1891 Cross and Bevan took out patents for the viscose process, and laid the foundations of the new industry. Viscose was originally regarded as suitable for lamp filaments, but soon its use in the manufacture of textile yarns was investigated, and the Viscose Spinning Syndicate Limited was formed to develop production. Courtaulds interested themselves in these discoveries and in 1904 they were persuaded by their chief chemist to take over the British patent rights for viscose spinning. Although this meant a transference of their activities to the chemical industry—and a new branch of it at that—they already possessed, through their finishing and dyeing interests, experience of industrial chemistry as applied to textiles which could be put to good account. They established a factory at Coventry, and in 1906 wove their first fabric of viscose yarn. Their output of yarn grew to nearly 3 million pounds by 1912, and much of this was woven in the firm's own mills. Their long-term policy, however, was to manufacture yarn for the market, and their rayon weaving activities were intended merely to demonstrate the possibilities of the new textile and to enable them to experiment with the use of rayon so that they might be in a position to give technical advice to their customers. Courtaulds also established a company in the United States, the American Viscose Company, which found a ready market in the hosiery industry. Later they collaborated with Continental firms in setting up rayon mills in Europe. By the end of the First World War Courtaulds' real silk business had become relatively small, and their output of fabrics dwarfed by the enormous growth in their rayon yarn production.

During the twenties the firm took a leading part in the technical improvements that occurred in the industry and in devising new uses for its product. In 1927 it began manufacture by the cellulose acetate process and extended its interests abroad. During the thirties it was a pioneer in the development of staple fibre in this country, a product

which it had first produced in the early twenties. To demonstrate the qualities of this new material, it installed spinning plants and acquired weaving mills both in Lancashire and Yorkshire. The firm also took up the manufacture of cellophane at this time. Immediately after the Second World War it became a large manufacturer of high tenacity rayon and developed the production of various synthetic fibres. Among the latter was nylon, for the manufacture of which it established British Nylon Spinners (in conjunction with Imperial Chemical Industries) and built a large factory at Pontypool. In 1957 it merged with British Celanese, the main British producer of acetate yarns. At present its range of output consists of viscose filament, viscose staple fibre, acetate filament and acetate staple fibre, protein and acrylic fibres, acetate films and plastics, spun rayon yarn and woven and warp-knitted rayon fabrics. It has long operated an engineering works where much of its machinery is produced. Despite Courtaulds' interests in the weaving, knitting and piece-dyeing sections of the industry, its primary concern has remained the production of rayon itself and, as in its early days, its activities in the later stages of manufacture have been regarded mainly as a means for creating a market for its major products. Since the war, conditions have favoured backward integration. The shortage of sulphur and of wood pulp, especially at the time of the Korean war, persuaded the firm of the necessity of securing its own supplies. It therefore set up chemical plants for producing sulphur and formed a South African company for supplying wood pulp.

Until its recent merger with Courtaulds the second largest producer was British Celanese. This firm began its existence during the First World War as a producer of "dope" for the fabric-covering of aeroplane wings. Then, at the end of the war, it turned to the manufacture of rayon by the cellulose acetate process. Numerous other firms were founded during the twenties. Several of them started soon after 1925, the year in which the industry received the protection of a high import duty, for this encouraged foreign producers (especially German and Dutch) to set up branch factories in this country. Newcomers were attracted also by the profitability of the industry, the prospects of increasingly successful competition with natural fibres and the expiry of the basic patents.¹ For a time competition in the industry was keen and Courtaulds lost some of its former predominance in the trade. This position, however, it soon

¹ Cf. D. C. Hague, *op. cit.*, pp. 30-1. In the late twenties the rayon industry was composed of about 30 companies.

regained, for the World Depression of 1929–31 ruined several of the newer firms, and during the later thirties the number of competitors was further reduced by closing or amalgamation. At present only seven firms are in production, and the Courtaulds-Celanese combine is probably responsible for nearly nine-tenths of the total output.¹ This concentration of production is common to the rayon industry in all countries, and is attributable to the conditions already described—the huge plants required for efficient operation and the heavy investment needed for development work in the man-made fibres industry as a whole.

The quasi-monopoly enjoyed by the chief producer has enabled it to act as price leader during most of its history. Nevertheless, there have been periods when it was faced with keen price competition, notably in the early twenties when imports were substantial, in the late twenties after the rise of new firms, and in the middle thirties when Courtaulds and British Celanese were rivals in acetate yarn production. Moreover, rivalry among rayon producers themselves has not been the only, nor even the most important, form of competition with which the producers have had to contend. The inter-war growth of the industry depended upon the acceptance of rayon as a substitute for the traditional fibres, and successive price reductions were necessary to render this competition effective. After the Second World War the expansion of rayon rested to a large extent on the policy of the producers in maintaining relatively low and stable prices at a time when cotton and other natural fibre prices were high and liable to violent fluctuations.² More recently, rayon has encountered serious competition not only because of the introduction of

¹ It employs about 31,000 persons.

² Since rayon is a manufactured fibre produced by an industry where capital costs are high in relation to prime costs, unit costs rise sharply as output falls below plant-capacity. The interest of producers lies, therefore, in maintaining output and producing for stock in periods of temporary depression and, as demand is very elastic, in price reductions. At the same time, since production is concentrated in a few hands, firms are able to avoid the violent short-term *fluctuations* in prices that are characteristic of the natural fibres. This gives rayon a favourable competitive position vis-à-vis the natural fibres, because customers in the textile industries prefer a product the use of which reduces their risks. The preference has become more strongly marked since the war because of the lack of satisfactory hedging facilities for raw cotton. The Chairman of Fine Spinners and Doublers Ltd., stated on July 18th, 1958: "The lack of hedging facilities forces a substantial risk on all traders in raw cotton and cotton goods. . . . Companies like our own must find means to offset changes in the valuation of stocks, but the existence of such hazards emphasizes the commercial attractions of man-made fibres . . . where the simplicity of trading is such as to provide, in contrast to cotton, a most powerful incentive to their use."

synthetic fibres but also through the fall in cotton prices at a time when rayon costs were rising. No doubt these conditions explain the increased concern of the leading producer with products other than rayon. Thus in rayon, as in many other branches of manufacture, the firm that enjoys a quasi-monopolistic position within its own industry is nevertheless vulnerable to competition from other industries or products that serve broadly the same markets.

The concentration of the British industry in a few hands was accompanied by the forging of links between British and foreign producers. It has been shown already that the leading firms in this country had in their early days acquired interests abroad and had associated themselves with foreign producers in establishing new branches of the industry. As the production of rayon extended, the world's chief manufacturers came to work in close association with one another. In the later twenties, for instance, vigorous price competition among European firms gave rise to agreements among them for standardizing and classifying their products and for reserving home markets for the several national groups of producers. Then, in 1929, the chief German firm, the Vereinigte Glanzstoff-fabriken (V.G.F.) arranged to exchange shares and directors with the great Dutch concern, the Algemeene Kunstzijde Unie (A.K.U.). This became the usual method for regulating competition, although it did not entirely supersede private international agreements for fixing import quotas. By 1939 the world's rayon industry was covered by a network of interlocking financial arrangements, and the leading British firm, besides owning subsidiaries in Germany, Canada and the United States, had interests in German, Italian and Swiss companies. For instance, the Dutch A.K.U. and the German V.G.F. controlled a German company that had been jointly floated, and together they had a controlling interest in Snia Viscosa, the largest Italian firm. At the same time, Courtaulds had subsidiaries in France, Canada and the United States and was associated with other concerns in Japan, the Argentine and elsewhere. The A.K.U. controlled companies in the United States, England and several Continental countries. British Celanese had subsidiaries in Canada and the United States and also an interest in German factories owned mainly by I.G. Farben. The German concern, J. P. Bemberg, controlled, or was associated with, numerous companies that used the cupra-ammonium process in England, the United States, Italy, Japan and Holland. These examples do not exhaust the list of international combinations or agreements in that period.

The war brought few lasting changes in these respects. Courtaulds lost its great United States subsidiary, the American Viscose Company in 1941, when the government sold it to provide dollars for the purchase of war supplies. But in 1953 Courtaulds again entered the American industry by establishing a viscose producing company in Alabama. Its other overseas interests were also enlarged, and in Europe the firm retained its heavy investments in and its close associations with the German Glanzstoff and the Italian Snia Viscosa concerns. In respect of these international relations, as well as in its internal structure, the rayon industry resembles the chemical industry rather than the older textile trades in which a high degree of concentration within each country and international links among the producers are unusual.

In its location, also, the rayon industry bears little resemblance to the older textile trades. These, including cotton, wool, jute, linen and lace, are all strongly localized; whereas rayon is widely dispersed. Courtauld's original rayon factory had been built at Foleshill, near Coventry. This site satisfied most of the conditions required for economical operation. Coventry had a good water supply and was within easy reach of the main centres of hosiery

PRODUCTION OF RAYON IN THE UNITED KINGDOM¹

(in million lb.)

<i>Year</i>	<i>Continuous Filament</i>	<i>Staple Fibre</i>
1913	7	—
1922	16	—
1925	28	—
1929	53	2
1935	108	8
1937	115	31
1939	115	58
1946	109	71
1950	198	173
1951	208	167
1952	145	125
1953	205	200
1954	201	224
1955	203	231
1956	193	236
1957	184	241

¹ Sources: *Survey of Textile Industries*, p. 305, for estimates for 1913, 1922 and 1925; *Rayon Organon*, and (after 1951) *Textile Organon*, for the rest.

production. Further, the district provided a large supply of young female workers who were needed for manipulating, winding and sorting the yarn; for the site was close to the mining town of Bedworth where, since the decay of the old silk-weaving trade in which the female members of the miners' families were once engaged, little employment for girls existed. Subsequently, Courtaulds set up factories in several other localities, and as new firms appeared, they too avoided any local concentration. Probably the very fact that

RAYON AND COTTON PRICES IN THE UNITED KINGDOM

(pence per lb.; annual averages)

Year	Fibre		Yarn		
	Viscose Rayon Staple $1\frac{1}{2}$ den.	Raw Cotton American Middling $\frac{3}{8}$ " ¹	Viscose Rayon Filament 150 den. Standard Bright Cake	Spun Rayon 36's Ring Tubes	Cotton American 36's Ring Tubes
1929 ...	36.0	9.1	57.0	—	16.5
1939 ...	10.1	7.5	30.5	18.2	11.6
1940 ...	11.4	8.7	36.3	20.6	15.3
1941 ...	12.7	9.1	44.5	22.8	17.1
1942 ...	16.5	8.4	47.5	26.9	—
1943 ...	17.0	9.5	47.5	27.4	—
1944 ...	14.5	12.8	47.5	25.6	—
1945 ...	14.0	12.8	45.8	25.8	—
1946 ...	14.0	19.5	45.0	26.6	25.6
1947 ...	14.8	20.5	42.7	28.3	33.0
1948 ...	16.5	22.8	43.0	30.6	36.5
1949 ...	17.8	24.9	43.0	35.5	43.1
1950 ...	18.6	35.8	44.0	37.7	60.5
1951 ...	24.8	46.5	53.8	51.3	80.6
1952 ...	26.8	39.3	54.0	49.6	62.5
1953 ...	25.5	31.8	54.0	49.3	55.5
1954 ...	24.0	33.0	54.0	48.4	58.0
1955 ...	24.0	31.7	54.0	48.4	57.7
1956 ...	24.0	26.9	54.0	47.1	57.0
1957 ² ...	24.0	25.2	60.0	48.8	57.6

¹ Liverpool Spot prices; pre-war, for $\frac{7}{8}$ "; up to and including 1946 for years beginning August 1st.

² September averages.

each of them needed a considerable labour force and an ample supply of good water precluded this; and many different places which were within easy reach of the chief consuming centres satisfied these conditions. To-day the principal centres of the industry are the North and West Midlands, Lancashire, Lincolnshire, North Wales and Northern Ireland.

PRODUCTION OF RAYON BY MAIN TYPES¹

(in million lb.)

		1939	1956
Filament:			
Acetate ... ..	...	37	61
Viscose Low Tenacity ...	...	78	69
Viscose High Tenacity ...	...	—	63
Staple:			
Acetate ... ..	...	—	9
Viscose ... ..	...	58	227
	TOTAL	<u>173</u>	<u>429</u>

BRITISH RAYON EXPORTS²

(in million lb.)

Year	Filament Yarn	Staple Fibre
1935	9	—
1937	14	6
1938	8	14
1939	7	31
1946	16	18
1950	26	22
1951	25	15
1952	20	22
1953	29	19
1954	30	24
1955	29	55
1956	34	29
1957	42	22

¹ Sources: *Rayon Organon* and *Textile Organon*.

² Source: *Trade and Navigation Returns*.

EXPORTS OF RAYON FABRICS¹

(in million square yards)

<i>Year</i>	<i>Wholly of Rayon</i>	<i>Rayon Mixtures</i>
1934	16	49
1935	15	35
1936	25	40
1937	39	40
1938	31	30
1939	44	29
1946	99	13
1947	97	13
1948	137	17
1949	161	19
1950	190	18
1951	198	22
1952	134	12
1953	152	17
1954	146	20
1955	113	15
1956	108	13
1957	96	16

¹ Source: *Trade and Navigation Returns*

CHAPTER XII

BUILDING

I

The Organization of Building Operations

The most striking indication of the economic importance of the building industry is given by the size of its annual output and by its contribution to capital formation. In 1957 the industry's total output (in Great Britain) was valued at £2,144 million, equivalent to about 11 per cent of the total expenditure on the gross domestic product, and between 1948 and 1957 it was responsible for nearly half of the country's total gross fixed capital investment. Over four-fifths of the output in recent years was supplied by the building and civil engineering firms themselves; government departments, local authorities, public utilities, including the electricity authorities and the railways, and private firms other than builders, accounted for the rest. In June 1957 the man-power engaged in building and contracting amounted to 1,519,000, about 14 per cent of the total number in all manufacturing industries (including building).

This great industry has a distinctive character which separates it sharply from other manufacturing industries. In the first place, production takes place not in a specialized centre of production but at the place where the product is used, and this gives rise to problems of organization and management that differ markedly from those found in the factory or mining trades. Secondly, building can be regarded as a "sheltered" industry, for although some firms of building contractors operate in several countries, the product itself cannot be moved across frontiers.¹ Thirdly, not only is the variety of the industry's work immense, but since every job is to a large extent individual in character, there are few opportunities to develop the mass-production methods which in recent decades have transformed many of the factory trades. This does not mean that building

¹ The fact that prefabricated houses were imported into Great Britain after 1945 is not inconsistent with this statement, for the site has to be prepared and the prefabricated sections assembled before such houses are available for occupation.

is immune from changes in technique and organization, but only that the scope for the application of modern manufacturing systems has so far been strictly limited. Finally, the industry is distinctive in that, over much of its output, responsibility for the finished product is diffused; that is to say, the builder or contractor often shares his responsibility for producing a finished building with several other types of persons or firms. This last feature of the trade will become clearer after we have described the main types of work with which the industry is concerned.

Much of its work comes to the building industry after a process of competitive tender. A prospective customer or building owner, who may be an individual, a firm or a public body, usually engages an architect to prepare plans and specifications for a particular building, although sometimes the customer himself, especially in the case of a local authority, may employ his own salaried staff for this purpose. The architect then invites tenders from a number of building contractors. When these come in, he advises on the choice of a contractor and, during the progress of the building operations, he supervises the work on behalf of his client. Another profession also is concerned with these operations, namely, that of the quantity surveyor. The quantity surveyor's main function is to give advice on the cost. He makes initial estimates based on the preliminary designs, and he prepares bills of quantities which analyse the work shown on the plans of the architect so that it can be priced by the contractors who are tendering for the job. As the building operations proceed, the quantity surveyor assesses the value of the work done in order that interim payments may be made to the contractor. Some buildings may be constructed by a single contractor with his own staff. But when the contract is of a considerable size, most contractors sublet part of their work to various types of specialists, and frequently sub-contractors are nominated by the architect after he has secured competitive tenders from among them. Sometimes consulting engineers are called in to prepare designs for special equipment which is afterwards supplied by sub-contractors. From this it will appear that for this type of building work there is absent that concentration of responsibility for the finished product that is to be found in most industries, even those mainly concerned with the assembly of components. The building contractor is, of course, charged with the duty of carrying out his contract, but for the provision of a finished building there is a division of responsibility among a number of separate firms. In Scotland this characteristic is even

more pronounced than in England, for in that country it is unusual for contracts to be let to a single main contractor, and normally the building owner enters into a number of separate contracts with independent firms that undertake particular jobs, such as the provision of brickwork, joinery, roofing and so forth. It follows that in Scotland the responsibilities of the architect for co-ordination are greater than in England.

By no means all the work undertaken by the building industry is organized in this way. For instance, some local authorities employ a building staff who not merely undertake the repair and maintenance of houses and other properties owned by them, but also build new houses. Some private firms, Government Departments and public utility concerns also undertake building work with their own staff. Again, up to 1939, a large number of houses were built speculatively, that is to say, the houses were built not on contract for particular clients, but in anticipation of sale, and since the abandonment of control over building in 1954, this type of work has been resumed on a considerable scale. Further, much of the work of the industry consists of the repair and maintenance of existing structures. Finally, the work of the building industry proper overlaps that of the civil engineering industry. Although a large part of civil engineering work (e.g. the making of roads, dams, bridges and electricity generating stations) is very different from that on which the builder is engaged, civil engineers are often called upon to erect and equip large buildings of a type similar to those with which the building industry itself is concerned. In such cases, the organization of the operations is different; the civil engineer normally designs the structure himself and complete responsibility for the finished product rests with him. The civil engineer thus combines the professional and the commercial functions, whereas in the building industry proper each of these functions is the concern of a specialist.

The character of the firms engaged in this industry is as various as the work which it has to perform. There are some very large firms, employing 1,000 or more persons on their regular staff, which carry out large building or civil engineering works all over the country. Some of them even operate abroad. Then there are firms of rather smaller size which undertake all but the largest jobs and usually confine their operations to a particular locality. Thirdly, there are the builders who are concerned mainly with the development of housing estates as speculative ventures. Fourthly, there are small

firms which divide their activities between repair and maintenance work and the erection of small numbers of new houses. Finally, there are the very small firms which occupy themselves almost exclusively with repair and maintenance.¹ These include the one-man firms or the firms in which the working proprietor is assisted by only one or two employees. All these firms can be regarded as general builders. But there are also firms which concentrate on a particular branch of building (e.g. plumbing, painting or roofing); these normally obtain their orders from main contractors who sub-contract work to them. In addition, there are firms of specialists who carry out operations in which expert technical knowledge is required. They include heating and ventilating engineers, electrical contractors and constructional engineers, and the use of their services is not, of course, confined to the building industry. The importance of this type of firm has grown with the increased elaboration in the equipment of buildings and with the wider application of scientific methods to building.

Before the war just under half the total value of the annual output of the building and civil engineering industry consisted of new houses, and just over a quarter consisted of building maintenance work. The rest was made up of factories, commercial buildings, schools and other institutional buildings, and of various kinds of civil engineering work. During the immediate post-war years the share taken by new housing was lower than formerly, while that of maintenance work and of non-housing work was greater, a change mainly attributable to the legacy of bomb damage left by the war. Most of the new housing work at that time was done to the orders of local authorities. Since 1953, however, the number of new houses built for private owners has risen substantially, and in 1957 the proportionate distribution of output (by value) was as follows:

						<i>Per cent of Total Value²</i>
Housing:						
For Public Authorities	...	...	...	...	...	17
For Private Owners	...	...	...	...	...	14
New Industrial Building (Private Owners)				...	...	15
Other New Work:						
For Public Authorities	...	...	...	...	...	21
For Private Owners	...	...	...	...	...	10
Repairs and Maintenance	...	...	...	...	...	23
TOTAL BUILDING AND CIVIL ENGINEERING WORK	...	...	...	...	...	<u>100</u>

¹ *Working Party Report on Building*, p. 3.

² Excluding the output of labour employed by public authorities.

Figures are also available to indicate the size distribution of firms in the industry. The Building Industry Working Party's Report showed that in May 1949 there were nearly 73,000 firms of building and civil engineers in Great Britain, apart from a very large number of firms (52,600) that employed no operatives. About 30 per cent of the labour force in the industry was employed by firms with less than 20 employees, and over 60 per cent by firms with less than 100 employees. Very large firms, each with more than a thousand employees, together employed only 12 per cent of the total number of operatives.¹ Firms in the various size-groups differ in the type of labour which they employ. About three-fifths of the workers in this industry consist of craftsmen as distinct from labourers. The small firms employ mainly craftsmen, whereas the large firms employ a high proportion of labourers. This follows, of course, from the different types of work upon which these classes of firm are severally engaged.

In isolation, figures showing the size-distribution of firms are liable to give a mistaken impression of the importance of very small firms from the standpoint of their contribution to output. Thus, in May 1948 over four-fifths of the production was turned out by 16,000 firms with more than 10 employees and half the output by about 1,500 firms with 100 or more employees. Even so it is clear that the tendency towards consolidation, which has been so pronounced in many of the factory trades during the present century, has had comparatively little effect in the building industry. During the inter-war period, indeed, it is probable that the number of firms increased in proportion to the expansion of output, and if, as has been said, "no material trend against the small firm" in British industry could be observed during that time, this could be largely attributed to the increase in the number of such firms in building.² In spite of the fall in the number of very small firms, especially the one-man firm, during the last ten years, the position has not radically changed.

The weakness of any trend towards consolidation can easily be explained by the character of the industry's operations. The technical and commercial economies of large scale are not available over much of the industry's work, which still depends to a greater extent

¹ *Working Party Report on Building*, p. 8. The "one-man firms" are excluded from these estimates.

² A. L. Bowley, letter in *The Times*, March 31st, 1941. According to the Census of Production, there were 49,900 building firms with more than one operative in 1924 and 72,690 in 1935. These figures cover Great Britain and Northern Ireland.

than in most trades on skilled craftsmanship; while the diseconomies of scale are substantial in a trade in which the centralized supervision of operations is far more difficult than in the factory industries. Consequently, building has remained a highly competitive industry. This competition has been maintained in a vigorous condition by the system of tendering for contracts, while during the inter-war period the activities of the speculative builders, who were themselves in keen rivalry with one another, provided a check on tender prices in the field of housing. The direct labour schemes of some of the local authorities also had the same effect. It is true that attempts were made from time to time to suppress competition. For instance, a scheme instituted for the London building industry during the thirties was directed towards removing any incentive to compete¹; but it could be said that on the whole the building industry, as distinct from the industries supplying building materials which were highly cartelized, was still faithful to competitive individualism.

Like all industries concerned with the production of capital goods, the building industry has been subject to wide periodical fluctuations in activity, although its periods of boom and depression have not always corresponded with those in the economy as a whole. In addition to this source of instability, moreover, the activities of the building industry are affected by several other influences. It is subject to seasonal fluctuations, both those for which the weather is responsible and those which arise from social habit, e.g. the concentration of the demand for house decoration in the spring. Before the war employment was normally at its lowest in January and reached its peak in May. After a decline in the early summer, there was a secondary peak in August. From then on there was a steady decline until and including January.² Variations in the weather from year to year, however, meant that there was less uniformity in the fluctuations of building employment than in those of seasonal factory work. Irregularity of employment was also caused by day-to-day variations in weather during every season. Further, official policy has had an important effect on building activity, and the growth in the Government's influence on the demand for the industry's resources during the last forty years has probably been detrimental to stability.

Apart from these external factors, the nature of building opera-

¹ See, Monopolies and Restrictive Practices Commission, *Report on the Supply of Buildings in the Greater London Area*.

² C. Saunders, *Seasonal Variations in Employment*, p. 173.

tions necessarily introduces an element of instability. In the course of the erection of a building a series of specialized craftsmen is employed at different stages, and although a firm with a full order book and efficient management may be able to organize the work of the various craftsmen so as to give continuous employment, these conditions cannot always be satisfied. Before the war builders were sometimes able to maintain an even flow of work through their business by dovetailing speculative building operations with those that resulted from their contracts; but, in spite of this, the margin of unemployment in the industry was high, even during years of prosperity. Thus, during the twenties and thirties when the industry grew substantially, average monthly unemployment was never less than 9.5 per cent.¹ It has been suggested that only about a fifth of the total normal inter-war unemployment could be attributed to seasonal variations, and there can be little doubt that the discontinuous nature of building operations themselves was the major cause. In other words, the industry was accustomed to work with a large reserve of labour, and the employers drew on this pool as they required particular types of workers and discharged them when their job was completed. The discontinuity of employment varied among the different classes of craftsmen. For instance, the joiners and carpenters enjoyed greater day-to-day stability of employment than the bricklayers. This was chiefly the result of the increasing tendency for much of the woodwork to be prepared in the workshop instead of on the site. So, the weather and "the necessity for working to a fixed succession of operations" are less important for the joiners than for those craftsmen who must perform all their work on the site.²

Because of the nature of building work, it is difficult to see how the industry can avoid shortages of labour at particular times, and so maintain efficiency, in the absence of this labour reserve; for if every employer gave a permanent engagement to a sufficient number of workers to meet his maximum needs for each type of craftsman, it would mean that he was himself maintaining his own reserve. This would be extravagant, since the sum of these individual reserves would be far greater than the central reserve required by the industry as a whole. The actual size of the pool may, of course, be reduced by the efficient organization of the labour market and by skilful business management. It may, perhaps, be argued that, because the building industry works with a comparatively small amount of fixed

¹ C. Saunders, *op. cit.*, p. 174.

² *Ibid.*, pp. 175-80.

capital, there is less incentive than in some other trades for the builder to plan his work so as to avoid frequent fluctuations in its volume, for the resources rendered idle in periods of slackness consist mainly of labour, and so the burden does not fall on the employer himself. Nevertheless, even with the most efficient management, the labour reserve can hardly be abolished without serious effects on costs. This contention will be illustrated later when we come to deal with the condition of the industry after 1945.

Although the fixed capital equipment of this industry remains small by the standards of the factory trades, it has increased considerably during the last forty years. This change has been associated with technical advances which, though not revolutionary, have been substantial. The introduction of machines for site preparation, tubular scaffolding, mechanical hoists and concrete mixers are instances of these advances. The rise in the cost of labour has encouraged the off-site preparation of materials and components, especially as this avoids the loss of output through bad weather.¹ In consequence, the use of ready-mixed concrete and of prefabricated joinery, which require the application of woodworking machinery in the builder's workshop, has been much extended. New methods of construction have come into being, and these have altered the character of much of the work. For instance, the steel-frame building, reinforced concrete structures and steel window frames, as well as the post-war prefabricated house, have called for new types of skill and equipment. On the other hand, there has been little extension in this country in the use of power-driven hand tools, in contrast with the widespread use of them in the United States.² In the civil engineering branch of the industry, the advance of mechanization has been more striking than in the building trade proper, and has greatly increased labour productivity. In civil engineering the use of these new methods has resulted in the displacement of the labourer rather than the skilled worker, but in building itself, where the proportion of skilled workers has always been much higher, the changed methods have done comparatively little to disturb the craft character of the work.

The more elaborate equipment, as is natural, is employed mainly by the larger firms; but it is available to medium and even to small firms, when the type of job is suitable, through the possibility of hiring plant. The medium and small firms are thus able to obtain

¹ It is estimated that bad weather causes an annual loss of output equivalent to the work of 50,000 men. *Times Review of Industry*, July 1958, p. 9.

² Anglo-American Productivity Council, *Report of Productivity Team*.

access to the economies yielded by this equipment without additional investment in fixed capital. The amount of working capital needed by the building firms is small in relation to the turnover, because of the financial practices of the industry. Firms obtain long credits from builders' merchants for their materials, and it is customary in large contracts for payments to be made on account of work done before the completion of the job. These financial facilities have made it easy for persons with very small capital to become builders, and they help to explain why the expansion in the industry during the inter-war years was associated mainly with the increase in the number of firms rather than with the growth in the size of existing firms. The development of the few large firms, which have all risen from small beginnings, has also owed much to the presence of these financial facilities. Other financial devices have been employed for some types of construction. Thus, large building projects are sometimes initiated by promoters who are not themselves builders, but who contract with building firms to carry out work planned and financed by them. In its financial organization, therefore, as well as in its structure, building retains many survivals of the early industrial period, and there is little likelihood that these will quickly disappear.

It does not follow that an industry where small firms predominate need necessarily be deprived of access to the results of modern scientific research. Where the scale required for research is greater than that required for production, an opportunity is given both for co-operative and for official activity. In building research the government has played a leading part. The Building Research Station, under the Department of Scientific and Industrial Research, has been responsible for many technical innovations, and the Ministry of Works has an elaborate service for communicating knowledge of new and improved methods to small firms. At the same time, the National Federation of Building Trade Employers has organized research committees and provided an advisory service for the industry.

II

The Industry Between the Wars

The building industry was one of the most rapidly expanding industries of the inter-war period. In the early twenties it was still suffering from the disorganization caused by the shrinkage in the

size of the industry during the First World War, when house-building and house maintenance were almost entirely suspended, and by the subsequent shortage of labour at a time when demand was very urgent. The building labour force had fallen from 920,000 in July 1914 to 438,000 at the time of the Armistice (November 1918), and even in July 1920 it stood at only 796,000.¹ Skilled labour was particularly scarce. Partly through this cause, and partly through the steep fall in productivity, the production of houses remained at a very low level for several years after the war. Meanwhile, the market for houses had been upset by war-time measures. Before 1914 house-building was carried on almost entirely by private enterprise, and the majority of working-class houses were owned by private landlords. In 1915 the Government took steps to prevent any rise in working-class rents, and although in 1919 an increase of 40 per cent was permitted, this was far less than the rise in prices and wages, and the legal rents for old houses remained much below the economic rents for new ones. In these circumstances the Government intervened by requiring local authorities to build working-class houses and by giving subsidies to private builders. Results were slow to appear and between January 1919 and September 1922 only 210,000 houses were built,² most of them with State assistance of one sort or another.³ The post-war slump led the Government to reduce its subsidies, and this brought a decline in house-building which continued until 1923. In that year an Act provided an annual subsidy of £6 a house for twenty years to local authorities and private builders for houses below a certain size. These houses could be let or sold at will. In the following year another Act provided higher subsidies for houses built for letting. Most of the houses built under the 1923 Act were undertaken by private enterprise, while most of those built for letting under the 1924 Act were constructed to the orders of the local authorities. Between 1923 and 1929 333,000 houses were built in England and Wales by the local authorities, and 367,000 by private enterprise with the aid of subsidies. The remainder (454,000 houses) were built by private enterprise without subsidies.⁴ The revival of private building after the middle twenties was closely associated with the

¹ A. C. Pigou, *Aspects of British Economic History, 1918-1925*, p. 92.

² In England and Wales.

³ L. R. Connor, "Urban Housing in England and Wales" in the *Journal of the Royal Statistical Society* (1936).

⁴ Ministry of Health, *Report of Committee on the Cost of House-building* (1948), p. 3.

decline in building costs. This had been brought about by a fall in wages and material prices and by an increase in productivity.

Apart from a downturn in 1928 and 1930, the house-building industry boomed through the rest of the inter-war period. As we have seen, in the early post-war years most of the houses were either constructed to the orders of local authorities or built under subsidy by private enterprise; and although the amount of unassisted house-building increased after 1922, throughout the whole of that decade State-assisted building predominated. The vast extension in the thirties, however, owed little to State assistance. The subsidy payable under the 1923 Act ceased in 1929 and that payable under the 1924 Act in 1932. This did not mean that the public authorities withdrew entirely from the field. Under legislation passed in 1930 and in subsequent years, subsidies were still made available to local authorities for particular tasks, such as slum clearance. It was, however, left to private enterprise to meet the bulk of the housing needs. The response was remarkable. Between 1930 and 1939 the annual output of houses reached a rate never before attained. In 1938 a record output of 341,000 houses was achieved for England and Wales; these included houses built both by private enterprise and by local authorities. During the inter-war period as a whole over 4 million houses were built in England and Wales. Of these three-quarters were built by private enterprise and the rest by local authorities. About 1½ million of these 4 million houses received some form of State subsidy.¹ In Scotland the position was different. There 337,000 houses were built between 1919 and 1939, and of these the local authorities provided over two-thirds. Even during the thirties, at the height of the boom in private enterprise building in England, it was left to the Scottish local authorities to provide the bulk of the new houses in that country.²

The building boom of the thirties was not, of course, confined to housing, for a great quantity of other construction was also undertaken by the industry. The boom was one of the most significant economic events of the period. The recovery of the British economy from the World Depression was very closely associated with this heavy investment in building which brought revival not merely to the trades directly connected with the industry but also to the economy as a whole, since it generated new purchasing power at a

¹ *Ibid.*, pp. 3-4.

² Department of Health for Scotland, *Scottish Building Costs* (1948).

time when a high proportion of the country's resources was unemployed.¹ The causes of the boom were various. The rise in real incomes which took place during these years made additional means available for expenditure on new accommodation, while the fall in the rate of interest in the early thirties reduced the cost of providing it. At the same time changes had taken place in habits of life which affected the demand. The coming of the cheap private motor-car and the improvement in public road transport not merely created a demand for houses and factories beyond the fringes of existing towns, but it also altered the demand for the kind of house required. Through the reduction in the size of families and the tendency to look for entertainment outside the home people now preferred small, easily run houses equipped with amenities not found in the older houses which reflected the requirements of the previous generation. Between 1914 and 1925, moreover, supply had been checked, first, by the cessation of building during the war and then by the continuance of rent control; while demand on the part of owner-occupiers had been kept down by the high price of building. There was, therefore, a dammed-up demand for new accommodation that a fall in price could render effective. Industrial changes also had their influence. The shift of industry from the older industrial areas to the south of England, and from the heart of cities to areas hitherto rural, created a demand both for new factories and houses and also for the institutional buildings of these new and rapidly growing communities. All these forces strengthened one another during the great building boom which had by no means spent itself when the Second World War broke out. If in Scotland the boom was less pronounced than in England and Wales, and if it depended there to a much greater extent on the activity of local authorities, this can be attributed to the relatively depressed condition of much of the Scottish economy and to the different organization of the Scottish building industry (for example, the absence of speculative builders).

¹ F. C. Benham, in *Great Britain under Protection*, p. 224, estimated that one-third of the increase that took place in employment after 1932 was due to the direct effects of the building boom. Cf. also, W. A. Lewis, *Economic Survey*, p. 87.

III

The Decline in Efficiency after 1939

The Second World War brought even more dislocation to this industry than did the First. For six years normal activities were almost entirely suspended. A rigid system of control was instituted with the result that private building virtually came to an end, and the resources of the industry were devoted to work needed for the prosecution of the war and to emergency repairs to bomb-damaged property. The industry was not protected from recruitment for the armed forces and by the middle of 1945 the number of insured workers had fallen to less than 600,000 compared with 1,362,000 in July 1939.¹ The normal processes of training came to an end, and many of the craftsmen who remained were engaged on work of a type to which they were not accustomed. At the end of the war the shrunken industry was faced with an enormous task in overtaking the arrears of work which had accumulated. Since it was believed that certain claims on the resources of the industry should be given priority (which could not be secured in a free market), the Government drew up a building programme based upon discussions that had taken place among the central departments, the local authorities and the industry, and upon preparations made as a result of these discussions even before the end of the war. The provision of new local authority houses for rent was held to be of first importance, and it was estimated in 1945 that some 750,000 new separate dwellings were needed to give every family a separate home, and half a million more to replace houses already condemned as unfit.² The plan set out in the White Paper of March 1945 was for the construction of 300,000 permanent houses in the first two years after the end of the European War and of 145,000 temporary houses.³ At the same time the repair of war-damaged property and the conversion of large houses into flats were to proceed simultaneously.

The task of providing this accommodation was made the responsibility of the local authorities. In the discharge of their duties these authorities were given both technical supervision by the Central Government and also financial subventions. Under the first head,

¹ These figures cover building and civil engineering in Great Britain.

² Ministry of Health, *Report of Committee on the Cost of House-building* (1948), p. 5.

³ *White Paper on Housing* (Cmd. 6609).

the Government laid down conditions about the types of houses to be constructed, and under the second, it provided substantial subsidies in various forms so that the houses might be let at rents within the means of those who were judged to need them most. The intention was to allot about three-fifths of the total labour force to housing work and more than half of this to new house construction. As there were other urgent demands on building resources, e.g. for private enterprise houses, repairs and maintenance, and industrial and commercial building, and as these demands in addition to those initiated by the Government for local authority housing were far in excess of the available capacity, the official programme could not have been carried out without rigid controls. These took the form of the licensing of building work and the allocation of scarce materials in the quantities needed to carry out the programme. The effect was greatly to restrict the production of industrial, commercial and institutional buildings as well as of houses other than local authority houses. For industrial building priority was given to factories established or extended in the Development Areas scheduled under the Distribution of Industry Act of 1945.

The execution of the Government's programme did not proceed smoothly, and very soon serious difficulties were encountered. The amount of work licensed or approved was greater than the industry could cope with, and even before the end of 1946 the authorities had to restrict the number of new houses started. It is true that the shortage of labour, which presented the main obstacle immediately after the war, was overcome within a few years, although the restoration of its quality proved to be a more intractable problem. Building operatives obtained early release from the Forces, and Government Training Centres were set up to deal with new recruits into the industry. By July, 1948, the labour force was approaching its pre-war size. But the scarcity of materials persisted and soon became the chief impediment to the expansion of output. Furthermore, throughout much of the post-war period, progress in the industry was handicapped by sudden modifications of the official programme in response either to the successive economic crises or to changes in housing policy. Since the industry provides a high proportion of the country's output of fixed capital goods, and since its activity largely depends on the decisions of the Central Government, it is necessarily very vulnerable to alterations in general economic conditions and in political objectives. For example, in 1947, the combined effect of a shortage of steel and an economic crisis was to compel the authorities

to reduce their housing programme and to check industrial building. Two years later the reduction in investment, which was imposed because of troubles with the balance of payments, was achieved largely by restrictions on new building. The outbreak of the Korean War in 1950 postponed the re-expansion of the industry and diverted resources from housing to Government work. In 1951 the authorities introduced an ambitious housing programme, which seemed practicable because by this time arrears of maintenance had been overtaken and war-damage work mostly completed. But, again, the industry became overloaded, and shortages of steel for a time seriously impeded progress. It was not until 1954 that supplies of all building materials became adequate and that the number of houses built reached the pre-war annual output.

Up to this time most of the houses had been built for the local authorities.¹ But a fundamental change in policy now occurred. Controls over materials, which had already been relaxed, were removed and building licensing was brought to an end. In 1955 the general subsidy on local authority housing was abolished (although subsidies for slum clearance and other special purposes remained), and private enterprise was left to provide the majority of the new houses required. The result was that the output of houses built to the orders of the local authorities and other public bodies declined, while the number built for private owners increased sharply. In 1951-2 the number in the latter class (in England and Wales) was only about 14 per cent of total completions; in 1957 the numbers in the two classes were about equal.² At the same time there was a considerable growth in industrial building.

Meanwhile the cost of building had soared to very high levels. Whereas in 1938-9 the typical three-bedroomed local authority house cost approximately £380 to build, the typical three-bedroomed house in 1947 cost £1,242.³ The cost of other types of building had risen to the same extent. Various factors were responsible for this increase. In the first place, the typical post-war local authority house was larger, better built and more lavishly equipped than its pre-war counterpart, and critics have condemned the Government's policy

¹ Between 1945 and 1954 about 1½ million permanent houses were built for local authorities in Great Britain. In addition, nearly 160,000 temporary houses were completed between 1945 and 1949, the duration of the official programme for that type of house. Up to and including 1954 about 370,000 permanent houses were built for private owners, half of them after 1951.

² In Scotland most of the houses, even after 1954, were built for the local authorities.

³ *Report on the Cost of House-building*, pp. 9-10.

of insisting upon the construction of better houses, since in the circumstances of the time this inevitably meant that fewer could be built. A second cause of the rise in cost was the increase in wages, material prices and other items, and the third cause was the fall in productivity. The Girdwood Committee put the increased labour-cost at £297 per house and estimated that the decline in productivity was responsible for £126 out of that sum.¹ Other evidence for building as a whole supports the conclusion that productivity in 1947 was only about two-thirds of that reached before the war. During the late forties and the fifties it made some recovery, but even in 1956-7 it was probably about a sixth lower than in 1938.² Averages for a whole industry are likely to conceal wide variations among firms, and there are serious conceptual as well as awkward statistical problems involved in these comparisons.³ Nevertheless it seems established that labour productivity in the industry during the post-war period has been substantially below that of the thirties.

It is significant that a similar fall in productivity took place during and just after the First World War and that several years elapsed before the industry had regained the efficiency achieved before 1914. It would appear that no substantial improvement was effected until 1924. From then onwards, however, productivity rose, and it is believed that by 1939 this advance had been sufficient to offset the effect on output per man-year of the reduction in the length of the normal working week that took place in 1919, and so to restore productivity to the pre-1914 level. In civil engineering, where mechanical methods were more generally applied during this period, the rise in productivity was probably much greater than in building proper. The effects of the two world wars on building efficiency were thus very similar, and it is worth while considering the causes of the decline so as to distinguish those common to both post-war periods from those peculiar to our own time.

During both wars the industry lost a high proportion of its experienced labour and it was unable to proceed with its normal processes of training. Even those who remained in the industry

¹ *Ibid.*, pp. 12-27.

² The Ministry of Works Index of Productivity (1938=100) rose from 75 in 1950 to 82 in 1956. Between 1949 and 1957 the price index for building and civil engineering (excluding repairs) rose by about 40 per cent, about the same as for manufactured products as a whole (other than food and tobacco).

³ See, *Report of Working Party on Building*, pp. 11-16, and Appendix F; cf., also, P. A. Stone and W. J. Reiners, "Organization and Efficiency of the House-Building Industry in England and Wales" in *Journal of Industrial Economics*, April 1954.

were often engaged on work which differed from that of peace-time. When peace was restored, the industry had to re-create its labour establishment very quickly, and its ranks thus came to be filled by a large proportion of inexperienced men and men whose skill had deteriorated. In an industry in which the craftsman still plays a leading part, these consequences were bound to be very serious for efficiency and to admit of no easy remedy. The difficulty was particularly great after the Second World War, both because it was more prolonged than the First, and also because the restoration of the labour force to its pre-war size took place very rapidly. The management of building firms had suffered in much the same way. Perhaps the most important effect of the war on management came through the alteration in market conditions. The manager's former pre-occupation with costs in a highly competitive market gave place between 1939 and 1945 to concern with speed in construction; in other words, war introduced quite other criteria of efficiency from those that existed in peacetime. These conditions alone, which were common to both post-war periods, were sufficient to reduce productivity. After the Second World War, however, there were other unfavourable circumstances. The industry was required to carry out a programme of work that was far in excess of its capacity, and in this connection the shortage of materials in relation to the size of this programme was even more damaging than the shortage of skilled men. The amount of work put in hand was so great that no stocks of materials could be built up, with the result that deliveries were irregular and interruptions of work on the site were consequently frequent. This was demoralizing for the workers. Attempts to overcome the shortages of particular materials by introducing substitutes also led to lower productivity, since work often had to be re-designed and employers and workers had to learn the use of unfamiliar materials.

Whereas after the First World War the boom came to an end within two years of the Armistice, after the Second World War inflation continued until the end of 1957 with hardly a respite. These conditions in the economy as a whole, which find their parallel in the building industry in the heavy overload of work, gave rise to serious problems of organization. Before the war, as we have seen, the industry, even in periods of expansion, was accustomed to operate with a large margin of unemployed workers, and this reserve ensured that the fluctuating demands for the various types of labour could be met easily as they arose. The absence of any reserve since the

war has meant that work has often been held up because of the lack of the particular type of operative at the time when he was needed. Some employers tried to overcome this difficulty by maintaining their own reserve of labour, and this has necessarily meant waste. "Full employment," as it has operated since the war, has had other effects on efficiency.¹ First, competition among employers for labour has led to a very high labour turnover. Second, since in these conditions even the least efficient employers can make profits, and the least competent workers can get continuous work, the average level of productivity is necessarily lower than in the conditions that existed before the war. Thirdly, the assurance of permanent employment is always likely to reduce the efforts of persons who were formerly kept up to the mark by fear of losing their job. From its very nature the work of a building operative cannot be subject to such close supervision as is possible in most factory employments, and his disposition towards his work was formerly influenced by his sense of responsibility on the one hand and by his fear of unemployment on the other. The first of these pillars of the pre-war system was shaken by the rapid expansion of the industry after 1945 and by the prevalence of general conditions unfavourable to the growth of a sense of responsibility; while the second was almost completely destroyed. Innovations that were intended to provide substitutes for the former sanctions, such as systems of payment by results which took the form of incentive bonus schemes, though adopted by the more progressive firms, were not greeted with much enthusiasm by large numbers of workers and employers. Full employment thus affected the disposition to work hard more profoundly in the building industry than in the factory industries.

Again, the alterations in the nature of the demand for building work, especially the concentration of the industry upon repairs and upon local authority housing, meant that some firms had to undertake work for which they were not suited, or in which they were given little opportunity for exercising their own *expertise*. This must have been damaging to their efficiency. Then the absence of speculative building for the market removed a type of building in which productivity was high. Before the war a building contractor often provided for the full use of his resources and for an even flow of work by undertaking speculative building to supplement his contract work. The disappearance of speculative building meant that the

¹ See, "Note on Full Employment," by the present author, in the *Working Party Report on Building*, Appendix G, pp. 83-4.

economies yielded by this combination of activities could no longer be secured. Further, it is contended that the complete control over design and specifications which the speculative builder enjoyed enabled him to turn out his products more cheaply than those made to contract. Thus, whatever may be said on aesthetic grounds against speculative building, there can be little doubt that its absence after 1945 was one of the several causes which led to lower productivity and higher costs.

Some of the causes that led to the fall in efficiency had disappeared by the middle fifties, and in other respects also conditions became more favourable. By then supplies of materials had considerably improved and operations were no longer seriously interrupted by temporary or local shortages; new building bye-laws which allowed greater freedom than formerly in the use of materials and techniques had been adopted by most local authorities; the mechanical equipment of the industry had been enlarged and improved; and speculative building had been resumed. Yet certain of the changes in the economic environment that had been responsible for the decline in efficiency remained. In particular, the persistence of inflationary conditions in the economy as a whole still exercised its pernicious effect on productivity, and adequate substitutes had not yet been found for the pressures, harsh but effective, that had existed before the war. As long as these conditions continue it will be very difficult for the industry to restore its pre-war level of efficiency, unless it succeeds in modifying its organization. The widespread adoption of incentive schemes of payment and the greater mobility of workers between crafts are among the proposals put forward as remedies. Certain other suggestions for effecting improvements in building efficiency, some of which were inspired by American methods of organizing building operations, were discussed in the Reports of the Building Industry Working Party and of the Productivity Team which visited the United States in 1949. Both these Reports advocate that more attention should be given to the detailed planning of building operations before work on the site actually begins.¹

We have shown that the building industry after 1945 was more intimately affected than almost any other private industry by particular acts of government intervention, and that the market as a determinant of what work should be done was for many years replaced by political and administrative decisions which tried to give expression

¹ A practice oddly known as "pre-planning".

to "social priorities." But it was not only by measures directed to the building industry itself that its operations were modified. The far-reaching influence of inflation on efficiency needs no further emphasis, but we may refer to government policies in other spheres which have exerted important indirect effects. The control over the use of land

NUMBER OF INSURED WORKERS IN BUILDING AND CONTRACTING IN THE UNITED KINGDOM¹

(in thousands)

<i>July</i>	
1924	860
1929	990
1932	1,147
1937	1,329
1939	1,406
1945	662
1948	1,267

MANPOWER IN BUILDING AND CONTRACTING IN GREAT BRITAIN²

(in thousands)

<i>June</i>	(a)	(b)
1939	1,310	
1945	722	
1948	1,375	1,450
1949		1,438
1950		1,434
1951		1,449
1952		1,435
1953		1,437
1954		1,454
1955		1,486
1956		1,541
1957		1,519
1958		1,495

¹ These figures of the number of insured workers are not precisely comparable. For the period 1924-7 persons aged 16 and over are covered; for the rest of the inter-war period the figures cover persons aged 16 to 64. In 1940 women aged 60 to 64 ceased to be included, while non-manual workers earning £250-£420 a year were brought in. The figure for 1948 includes an estimate for Northern Ireland. (Source: *Ministry of Labour Gazette*.)

² This table covers employers and self-employed as well as employees. The figures under (a) are for males under 65 and females under 60, but exclude persons unemployed. The figures under (b) cover all persons aged 15 and over at work or registered as available for work.

that was instituted by the Town and Country Planning Act of 1947 and by earlier legislation of the same kind has affected building development both in respect of the places where it can occur and also its type and total amount. In industrial building, the provisions of the Distribution of Industry Act of 1945 have had similar consequences. Finally, though the industry has lately regained a greater measure of freedom, it has remained very susceptible to acts of general economic policy such as those designed to restrict investment during the recurrent balance of payments crises.

SELECT BIBLIOGRAPHY

In general, works that deal mainly with the history of industry before 1920 and also the more obvious sources of statistical data have been omitted.

J.R.S.S. . . . *Journal of the Royal Statistical Society*
E.J. . . . *Economic Journal*

I. COAL

Books, Periodicals and Articles

BEACHAM, A., "Efficiency and Organization of the British Coal Industry" in *E.J.*, June–September 1945.

"The Present Position of the Coal Industry in Great Britain" in *E.J.*, March 1950.

"Planned Investment in the Coal Industry" in *Oxford Economic Papers*, June 1951.

"Price Policy in the Coal Industry" in *Journal of Industrial Economics*, April 1953.

"Fuel and Power Policy in Great Britain" in *Journal of Industrial Economics*, December 1954.

BROWNE, E. H., "Improving Coal Production" in *Journal of the Royal Society of Arts*, June 1953.

COURT, W. H. B., *Coal* (History of the Second World War, U.K. Civil Series), 1951.

DENNISON, S. R., "The Price Policy of the National Coal Board" in *Lloyds Bank Review*, October 1952.

HOULDSWORTH, H., "The Pits of Britain" in *Transactions of the Manchester Statistical Society*, 1952–3.

Iron and Coal Trades Review, Weekly.

JEVONS, H. S., *The British Coal Trade*, 1920.

JEVONS, W. S. *The Coal Question* (3rd Edition), 1906.

JONES, J. H., "Organized Marketing in the Coal Industry" in *E.J.*, March 1929.

"The Present Position of the Coal Trade" in *J.R.S.S.*, Part I, 1930.

The Coal Mining Industry, 1939.

- LITTLE, I. M. D., *The Price of Fuel*, 1953.
- LUCAS, A. F., "A British Experiment in the Control of Competition: The Coal Mines Act of 1930" in *Quarterly Journal of Economics*, May 1934.
- MACGREGOR, D. H., "The Coal Bill and the Cartel" in *E.J.*, March 1930.
- MUNBY, D. L., "The Price of Fuel" in *Oxford Economic Papers*, September 1954.
- NEUMAN, A. M., *Economic Organization of the British Coal Industry*, 1934.
- P.E.P., *The British Fuel and Power Industries*, 1947.
- ROBERTS, A., "Marketing under the Coal Mines Act, 1930" in *The Manchester School*, Vol. IX, No. 1, 1938.
- SALES, W. H., "Changing Patterns of Pit Performance" in *Journal of Industrial Economics*, July 1955.
- THOMAS, D. A., "The Growth and Direction of our Foreign Trade in Coal during the Last Half-Century" in *J.R.S.S.*, September 1903.

Official Publications

- COAL MINES REORGANIZATION COMMISSION, *Memorandum on Colliery Amalgamation*, 1931.
- Reports to Secretary for Mines*, 1933-8.
- LEAGUE OF NATIONS, ECONOMIC SECTION, *Memoranda on Coal* (2 vols.) (International Economic Conference, 1927).
- The Problem of the Coal Industry*, 1929.
- The Coal Problem*, 1932.
- MINES DEPARTMENT, *Report of Committee on Co-operative Selling in the Coal-mining Industry*, 1926.
- Annual Reports*.
- MINISTRY OF (FUEL AND) POWER, *Report of Technical Advisory Committee on Coal-mining*, 1945.
- Regional Coalfield Survey Reports*, 1945-6.
- Report of Committee on National Policy for the Use of Fuel and Power Resources*, 1952.
- Report of Committee of Inquiry into Coal Distribution Costs in Great Britain*, 1958.
- Statistical Digest*, Annual.
- MINISTRY OF TRANSPORT AND MINES DEPARTMENT, *First Report of the Standing Committee on Mineral Transport*, 1929.

- NATIONAL COAL BOARD, *Annual Reports and Statements of Accounts. Plan for Coal*, October 1950.
Report of Advisory Committee on Organization (Fleck Committee), 1955.
Investing in Coal, 1956.
- ROYAL COMMISSIONS ON THE COAL INDUSTRY, 1919 and 1925, *Reports*.

II. METALS AND ENGINEERING

Books, Periodicals and Articles

- ANDREWS, P.W. S. and BRUNNER, E., *Capital Development in Steel: A Study of the United Steel Companies, Ltd.*, 1951.
- ANGLO-AMERICAN COUNCIL ON PRODUCTIVITY, *Iron and Steel*, 1952.
- BEESLEY, M., "Changing Locational Advantages in the British Motor Car Industry" in *Journal of Industrial Economics*, October 1957.
- BENHAM, F., *The Iron and Steel Industry of Germany, France, Belgium, Luxembourg and the Saar* (London and Cambridge Economic Service), 1934.
- BIRKETT, M. S., "The Iron and Steel Industry During the War" in *J.R.S.S.*, Part III, 1920.
"The Iron and Steel Industry Since the War" in *J.R.S.S.*, Part III, 1930.
- BRITISH IRON AND STEEL FEDERATION, *Statistics of the Iron and Steel Industries*, 1934-9. Annual.
The Statistical Handbook (formerly the *Statistical Year-book*), Annual.
Steel Review, Quarterly.
Monthly Statistical Bulletin (since 1956 published jointly by Iron and Steel Board).
- BURN, D. L., *The Economic History of Steelmaking, 1867-1939*, 1940.
- DENNISON, S. R. "Some Aspects of Automation" in *National Provincial Bank Review*, August 1956.
- DUNCAN, H. O., *The World on Wheels*, 1926.
Encyclopaedia of the Social Sciences, Vol. III, "The Automobile Industry", 1931.
- FAYLE, C. E., *The War and the Shipping Industry*, 1927.
- FOLDES, L., "Iron and Steel Prices" in *Economica*, November 1956.
- HUNTER, E., "The Steel Industry in 1954" in *National Provincial Bank Review*, February 1954.
- INSTITUTE OF AUTOMOBILE ENGINEERS, *Proceedings*, Annual.

- INSTITUTE OF MECHANICAL ENGINEERS, *Proceedings*, Annual.
Iron and Coal Trades Review, "Steel and Britain's Future", September 1949.
- JONES, L., *Shipbuilding in Britain*, 1957.
- LANGLEY, S. J., "The Locational Problems in the British Steel Industry" in *Oxford Economic Papers*, June 1951.
- LLOYD'S REGISTER OF SHIPPING, *Annual Summaries of the Mercantile Shipbuilding of the World*.
- MINCHINTON, W. E., *The British Tinplate Industry: A History*, 1957.
- P.E.P., *Motor Vehicles*, 1950.
- SARA, E. T., "Progress in the United Kingdom Iron and Steel Industry" in *Yorkshire Bulletin of Economic and Social Research*, May 1957.
- SOCIETY OF MOTOR MANUFACTURERS AND TRADERS, *The Motor Industry of Great Britain*, Annual.
- WANSBROUGH, G., "Automobiles: The Mass Market" in *Lloyds Bank Review*, October 1955.

Official Publications

- BOARD OF TRADE, *Report of Committee on the Shipping and Shipbuilding Industries after the War*, 1918.
Report of Committee on the Iron and Steel Trades after the War, 1918.
- COMMITTEE ON INDUSTRY AND TRADE, *Survey of the Metal Industries*, 1928.
- DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, *Report on Automation*, 1956.
- EUROPEAN COAL AND STEEL COMMUNITY, *Annual Reports*.
- IMPORT DUTIES ADVISORY COMMITTEE, *Report on Present Position and Future Prospects of the Iron and Steel Industry*, 1932.
Report on Present Position and Future Development of the Iron and Steel Industry, 1937.
- IRON AND STEEL BOARD, *Development in the Iron and Steel Industry, 1953-8*, February 1955.
Development in the Iron and Steel Industry: Special Report, July 1957.
- Iron and Steel Reorganization Scheme: Correspondence between National Committee for the Iron and Steel Industry and the Import Duties Advisory Committee*, 1933.
- LEAGUE OF NATIONS, ECONOMIC SECTION, *Memoranda on Engineering*,

Iron and Steel, and Shipbuilding (International Economic Conferences, 1927.)

MINISTRY OF SUPPLY, *Reports of British Iron and Steel Federation and Joint Ironfoundry Council on the Iron and Steel Industry*, 1946.

NATIONAL ADVISORY COUNCIL FOR THE MOTOR MANUFACTURING INDUSTRY, *Report on Proceedings*, October 1947.

III. TEXTILES

Books, Periodicals and Articles

ALLEN, G. C., "The Report of the Working Party on the Cotton Industry" in *The Manchester School*, October 1946.

AVRAM, M. H., *The Rayon Industry*, 1933.

BARLOW, T. D., "Surplus Capacity in the Lancashire Cotton Industry" in *The Manchester School*, Vol. VI, No. 1, 1935.

BEHRENS, L. F., "The Functions of a Manchester Shipping Merchant" in *The Manchester School*, Vol. I, No. 2, 1930-1.

BLAU, G., "Wool in the World Economy" in *J.R.S.S.*, Part III, 1946.

BROTHWELL, J. F., "The 1951 Depression in the British Wool Industry" in *Yorkshire Bulletin for Economic and Social Research*, September 1952.

BURNETT-HURST, A. R., "Lancashire and the Indian Market" in *J.R.S.S.*, Part III, 1932.

DANIELS, G. W. and JEWKES, J., *The Comparative Position of the Lancashire Cotton Industry and Trade* (Manchester Statistical Society), 1927.

"The Post-war Depression in the Lancashire Cotton Industry" in *J.R.S.S.*, Part II, 1928.

"The Crisis in the Lancashire Cotton Industry" in *E.J.*, March 1927.

ELLINGER, B. and H., "Japanese Competition in the Cotton Trade" in *J.R.S.S.*, Part II, 1930.

HAGUE, D. C., *The Economics of Man-Made Fibres*, 1957.

HENDERSON, H. D., *The Cotton Control Board*, 1922.

JEWKES, J., "The Localization of the Cotton Industry" in *Economic History*, January 1930.

JEWKES, J. E. and GRAY, E. M., *Wages and Labour in the Lancashire Cotton Spinning Industry*, 1935.

KENYON, H., *The Shape and Size of the Export Merchanting Section of the Cotton Industry* (Manchester Statistical Society), 1944.

- NETTL, P., "Some Economic Aspects of the Wool Trade" in *Oxford Economic Papers*, July 1952.
- PHILPOTT, B. P., "Fluctuations in Wool Prices, 1870-1953" in *Yorkshire Bulletin of Economic and Social Research*, January 1956.
- Rayon Organon* (after 1951 *Textile Organon*), Annual.
- ROBSON, R., *The Cotton Industry in Britain*, 1957.
- The Man-Made Fibres Industry*, 1958.
- RYAN, J., "Machinery Replacement in the Cotton Trade" in *E.J.*, December 1930.
- SHIMMIN, A. N., *The Present Position and Prospects in the Wool Textile Industry* (London and Cambridge Economic Service), 1925.
- WARD-JACKSON, C. H., *A History of Courtaulds*, 1941.
- WISEMAN, J. and YAMEY, B. S., "The Raw Cotton Commission" in *Oxford Economic Papers*, February 1956.
- WOOL TEXTILE DELEGATION, *Wool Textile Bulletin*. Monthly.
- YAMEY, B. S., "Future Trading in Cocoa, Rubber and Wool Tops" in *The Three Banks Review*, September 1954.

Official Publications

- BLAU, G., *World Fibre Survey* (United Nations, Food and Agriculture Organization), 1947.
- BOARD OF TRADE, *Report of Committee on the Textile Trades after the War*, 1918.
- Reports of Working Parties on Cotton* (1946), *Lace* (1947), *Wool* (1947), *Jute* (1948), *Hosiery* (1946), *Carpets* (1948).
- Report of the Cotton Import Committee*, 1952.
- COMMITTEE ON INDUSTRY AND TRADE, *Survey of Textile Industries*, 1928.
- COTTON BOARD, *Report of Committee to Enquire into Post-war Problems*, 1944.
- Modernization in the Cotton Spinning Industry*, 1948.
- Trade Letter, Quarterly Statistical Review*.
- COTTON MANUFACTURING COMMISSION, *Reports on Wages Arrangements and Methods of Organization of Work in the Cotton Manufacturing Industry*, 1948, 1949.
- COURT OF INQUIRY CONCERNING DISPUTE IN NORTHERN COUNTIES WOOL TEXTILE INDUSTRY, *Report*, 1930.

- ECONOMIC ADVISORY COUNCIL, *Report of Committee on the Cotton Industry*, 1930.
- MINISTRY OF PRODUCTION, *Report of Cotton Textile Mission to the United States*, 1944.
- MONOPOLIES AND RESTRICTIVE PRACTICES COMMISSION, *Report on the Process of Calico-Printing*, 1954.
- RAW COTTON COMMISSION, *Annual Reports*.
Reports of Commission Set Up to Review Wages Arrangements and Methods of Organization of Work in the Cotton Spinning Industry, 1945, 1946.
- WOOLLEN AND WORSTED COMMITTEE APPOINTED UNDER THE SAFEGUARDING OF INDUSTRIES ACT, *Report*, 1929.

IV. OTHER INDUSTRIES AND GENERAL

Books, Periodicals and Articles

- ALLEN. G. C., *The Industrial Development of Birmingham and the Black Country*, 1929.
- “United Kingdom” in *Monopoly and Competition and Their Regulation* (Ed. Chamberlain, E. H.), 1954.
- “The British Economy” in *Economic Systems of the West*, Vol. I (Ed. Frei, R., *Kyklos*), 1957.
- ANDREW, P. W. S., *Manufacturing Business*, 1949.
- BEVERIDGE, W. H., *Unemployment*, 1930.
- BOWEN, I. and ELLIS, A. W. T., “The Building and Contracting Industry” in *Oxford Economic Papers*, No. 7, 1945.
- BRONOWSKI, J., “Output Problems in House Building” in *The Advancement of Science*, December 1950.
- BROWN, A. J., *Applied Economics*, 1947.
- BURN, D., (Ed.), *The Structure of British Industry* (2 vols.), 1958.
- CARTER, C. F. and WILLIAMS, B. R., *Industry and Technical Progress*, 1957.
- CASSELL, F., “The Pricing Policy of the Nationalized Industries” in *Lloyds Bank Review*, October 1956.
- CORLETT, W. J., *The Economic Development of Soap and Detergents*, 1958.
- DENNISON, S. R., *The Location of Industry and the Depressed Areas*, 1939.
- DONNITHORNE, A. G., *British Rubber Manufacturing*, 1958.
- DUKE UNIVERSITY, *The Nationalization of British Industries (Law and Contemporary Problems)*, 1951.

- DUNNING, J. H., *American Investment in British Manufacturing Industry*, 1958.
- ECONOMICS AND STATISTICS SECTION OF THE BRITISH ASSOCIATION, *Britain in Depression*, 1935.
Britain in Recovery, 1938.
- ECONOMIST INTELLIGENCE UNIT, *Britain and Europe*, 1957.
- FITZGERALD, P., *Industrial Combination in England*, 1927.
- FOGARTY, M. P., *Prospects of the Industrial Areas of Great Britain*, 1945.
- FOLDES, L., "The Control of Nationalized Industries" in *Public Law*, Summer 1957.
- HANCOCK, W. K. and GOWING, M. M., *History of the Second World War: British War Economy*, 1949.
- HARGREAVES, E. L. and GOWING, M. M., *History of the Second World War: Civil Industry and Trade*, 1952.
- HART, F. E. and PRAIS, S. J., "The Analysis of Business Concentration: A Statistical Approach" in *J.R.S.S.*, Part II, 1956.
- INSTITUTE OF PETROLEUM, *The Post-war Expansion of the U.K. Petroleum Industry*, 1954.
- JEWKES, J., SAWERS, D. and STILLERMAN, R., *The Sources of Invention*, 1958.
- LEWIS, W. A., *Overhead Costs*, 1949.
Economic Survey, 1919-1939, 1949.
- LIBERAL INDUSTRIAL INQUIRY, *British's Industrial Future*, 1928.
- LIESNER, H. H., "The European Common Market and British Industry" in *E.J.*, June 1958.
- LOVEDAY, A., *Britain and World Trade*, 1931.
- LUCAS, A. F., *Industrial Reconstruction and the Control of Competition*, 1937.
- MACGREGOR, D. H., *Enterprise, Purpose and Profit*, 1934.
- MAIZELS, A. and LEAK, H., *The Structure of British Industry* (Royal Statistical Society), 1945.
- MANCHESTER UNIVERSITY ECONOMICS RESEARCH SECTION, *Readjustment in Lancashire*, 1936.
- MELMAN, S., *Dynamic Factors in Industrial Productivity*, 1956.
- NATIONAL INSTITUTE OF ECONOMIC AND SOCIAL RESEARCH, *A Classified List of Large Companies Engaged in British Industry*, 1955.
Company Income and Finance, 1949-53, 1956.
- PIGOU, A. C., *Aspects of British Economic History, 1918-1925*, 1947.
- PLUMMER, A., *New British Industries in the Twentieth Century*, 1937.

- RICHARDSON, J. H., *Industrial Employment and Unemployment in West Yorkshire*, 1936.
- ROBSON, P., "Growth of Employment and Diversification of Industry in the Development Areas" in *Oxford Economic Papers*, February 1956.
- ROBSON, W. A., (Ed.) *Problems of Nationalized Industry*, 1952.
- ROSTAS, L., *Productivity, Prices and Distribution in Selected British Industries*, 1948.
- Comparative Productivity in British and American Industry*, 1948.
- "Changes in Productivity of British Industry, 1945-51" in *E.J.*, March 1952.
- SAUNDERS, C., *Seasonal Variations in Employment*, 1936.
- SAYERS, R. S., "The Springs of Technical Progress in Britain" in *E.J.*, June 1950.
- STURMEY, S. G., *The Economic Development of Radio*, 1958.
- SYKES, J., "The Distribution of Industry" in *National Provincial Bank Review*, May 1956.
- WILLIAMS, T. I., *The Chemical Industry*, 1953.
- WRAY, M., *The Women's Outerwear Industry*, 1958.

Official Publications

- ANGLO-AMERICAN COUNCIL ON PRODUCTIVITY, Productivity Team, *Report on Building*, 1950.
- BOARD OF TRADE, *Industrial Surveys of Merseyside, the Lancashire Area, the North-east Coast Area, the South-west of Scotland Area, and South Wales*, 1932.
- Reports of Working Parties on Pottery* (1946), *Boots and Shoes* (1946), *Furniture* (1946), *Linoleum* (1947), *Light Clothing* (1947), *Heavy Clothing* (1947), *Jewellery and Silverware* (1946), *Cutlery* (1947), *Handblown Domestic Glassware* (1947).
- Report of the Committee on Resale Price Maintenance*, 1949.
- The Distribution of Industry*, 1948.
- COMMITTEE OF INQUIRY INTO THE ELECTRICITY SUPPLY INDUSTRY, *Report*, 1956.
- COMMITTEE ON FINANCE AND INDUSTRY, *Report and Evidence*, 1931.
- COMMITTEE ON INDUSTRY AND TRADE, *Survey of Overseas Markets*, 1925.
- Survey of Industrial Relations*, 1926.
- Factors in Industrial and Commercial Efficiency*, 1927.

- Further Factors in Industrial and Commercial Efficiency*, 1928.
Final Report, 1929.
- COUNCIL ON PRICES, PRODUCTIVITY AND INCOMES, *First Report*, 1958.
- DEPARTMENT OF HEALTH FOR SCOTLAND, *Scottish Building Costs*, 1948.
- MINISTRY OF HEALTH, *The Cost of House-building* (1st Report), 1948.
The Cost of House-building (2nd Report), 1950.
- MINISTRY OF WORKS, *Report of Working Party on the Building Industry*, 1950.
- MONOPOLIES AND RESTRICTIVE PRACTICES COMMISSION, *Collective Discrimination*, 1955.
Report on the Supply of Buildings in the Greater London Area, 1954.
- See, also, the Commission's Reports on Various Industries, 1950-6.
- ROYAL COMMISSION ON THE DISTRIBUTION OF THE INDUSTRIAL POPULATION, *Report*, 1940.
Statistical Tables Relating to British and Foreign Trade and Industry, 1924-30 (2 vols.).

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